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1400 FOUNTAIN GROVE PARKWAY, SANTA ROSA, CALIFORNIA, 95404, U.S.A.

Refer to Appendix I for Instruments  
Serial Prefixed 532 - and 541 -

SERIALS PREFIXED: 649- 737-

# MODEL 8406A FREQUENCY COMB GENERATOR

## OPERATING AND SERVICE MANUAL



## SAFETY CONSIDERATIONS

**GENERAL** — This is a Safety Class I instrument (provided with terminal for protective earthing).

### OPERATION — BEFORE APPLYING POWER

verify that the power transformer primary is matched to the available line voltage, the correct fuse is installed, and Safety Precautions are taken (see the following warnings). In addition, note the instrument's external markings which are described under "Safety Symbols."

## WARNINGS

Servicing instructions are for use by service-trained personnel only. To avoid dangerous electric shock, do not perform any servicing unless qualified to do so.

### BEFORE SWITCHING ON THE INSTRUMENT,

the protective earth terminal of the instrument must be connected to the protective conductor of the (mains) power cord. The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action must not be negated by the use of an extension cord (power cable) without a protective conductor (grounding). Grounding one conductor of a two conductor outlet is not sufficient protection. If this instrument is to be energized via an auto-transformer (for voltage reduction) make sure the common terminal is connected to the earth terminal of the power source.

Any interruption of the protective (grounding) conductor (inside or outside the instrument) or disconnecting the protective earth terminal will cause a potential shock hazard that could result in personal injury.

Whenever it is likely that the protection has been impaired, the instrument must be made inoperative and be secured against any unintended operation.

Only fuses with the required rated current, voltage, and specified type (normal blow, time delay, etc.) should be used. Do not use repaired fuses or short circuited fuseholders. To do so could cause a shock or fire hazard.

Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

Do not install substitute parts or perform any unauthorized modification to the instrument.

## SAFETY SYMBOLS

Adjustments described in the manual are performed with power supplied to the instrument while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Any adjustment, maintenance, and repair of the opened instrument under voltage should be avoided as much as possible, and when inevitable, should be carried out only by a skilled person who is aware of the hazard involved.

Capacitors inside the instrument may still be charged even if the instrument has been disconnected from its source of supply.



Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect against damage to the product.



Indicates hazardous voltages.



Earth terminal (sometimes used in manual to indicate circuit common connected to grounded chassis).

## WARNING

The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

## CAUTION

The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

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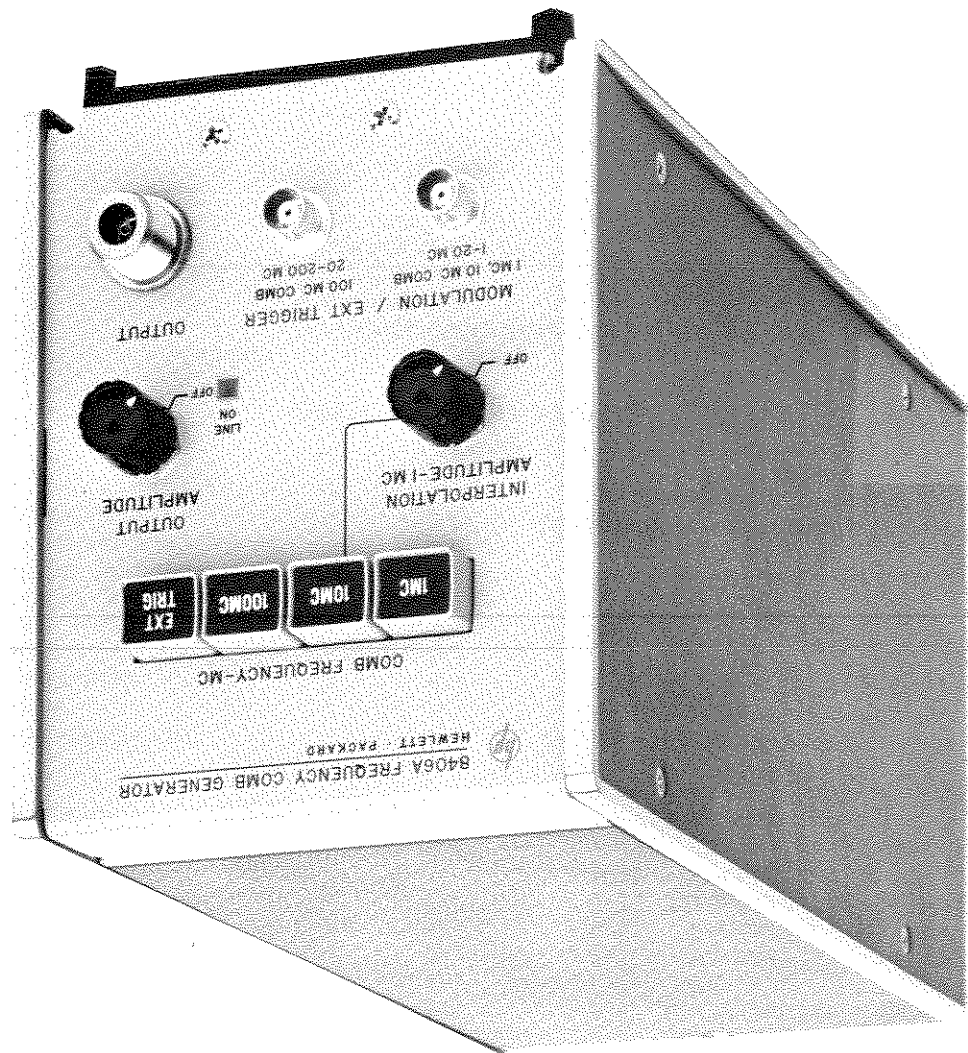
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Figure 1-1. Frequency Comb Generator



Section I  
Figure 1-1

Model 8406A

## SECTION I GENERAL INFORMATION

### I-1. DESCRIPTION.

I-2. The hp Model 8406A supplies a frequency comb with a selectable spectral line spacing of 1 Mc, 10 Mc, 100 Mc, or the frequency of an external trigger signal. The frequency comb generated is usable to at least 4 Gc.

I-3. The Model 8406A provides these additional features:

a. Output level is continuously variable by a front panel control.

b. Interpolation amplitude level is continuously variable by a front panel control.

c. Comb frequency or external trigger frequency is selectable by front panel pushbuttons. This switch will not permit more than one button to be actuated at a time to avoid confusion in the output signal.

- d. Front panel BNC jacks are provided for modulation and external trigger frequencies.
- e. A switch is provided on the rear apron to switch the instrument to 230-volt operation.

### I-4. INSTRUMENT IDENTIFICATION.

I-5. Hewlett-Packard uses a two-section, eight-digit serial number (on instrument rear panel) to identify instruments (000-00000). The first three digits are a serial prefix number, and the last five digits refer to a specific instrument. If the serial prefix on your instrument does not appear on the title page of this manual, there are differences between the manual and your instrument which are described in a Manual Change sheet included with this manual or in the Appendix (if any). If this information is missing, it can be supplied by your nearest Hewlett-Packard field office.

Comb Fundamental Frequencies: 1, 10, and 100 Mc, pushbutton selected, generate harmonically related signals usable to beyond 5 Gc.

Comb Frequency Accuracy:  $\pm 0.01\%$  (0° to 50°C).

Peak Amplitude\*:

1 Mc Comb	10 Mc Comb	100 Mc Comb
> 80 dBm	> 60 dBm	-
> 1.0 Gc	> 45 dBm	-
0.5-2.0 Gc	> 70 dBm	> 50 dBm
1-2 Gc	-	> 35 dBm
2-4 Gc	> 82 dBm	> 62 dBm
	> 47 dBm	> 47 dBm

\*Peak signal level defined in terms of equipment CW signal level (as measured on hp 8551B/851B Spectrum Analyzer).

OUTPUT AMPLITUDE control permits continuous level adjustment.

Comb Output Connector: Type N female, source impedance approximately 50 ohm.

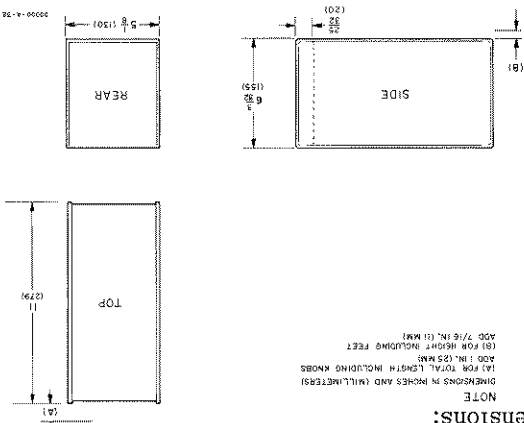
Maximum External Signal at Comb Output: Signals exceeding 1 watt (pk and av) may cause damage.

Interpolation Function: 10-Mc and 1-Mc combs can be combined into primary-secondary comb; Interpolation Amplitude control adjusts level of secondary (1 Mc) signal.

External Modulation: External modulation signals can be used to phase modulate any of the combs to produce sidebands for interpolation between fixed comb markers<sup>1</sup>. BNC female connector.

External Trigger: External signals (normally sine waves) between 1 Mc and 200 Mc can be used to produce combs spaced at frequency of trigger signals<sup>2</sup>. BNC female connector.

Power: 115 or 230 volts  $\pm 10\%$ , 50-400 cps, 2 watts



Weight: Net 6 lb (2.7 Kg); shipping 9 lb (4.1 Kg)

<sup>1</sup>External modulation: Modulation frequencies can be as low as 5 kc. Although the level of modulation voltage required varies with modulating frequency and the harmonic number of the comb being modulated, the information here will serve as a guide:

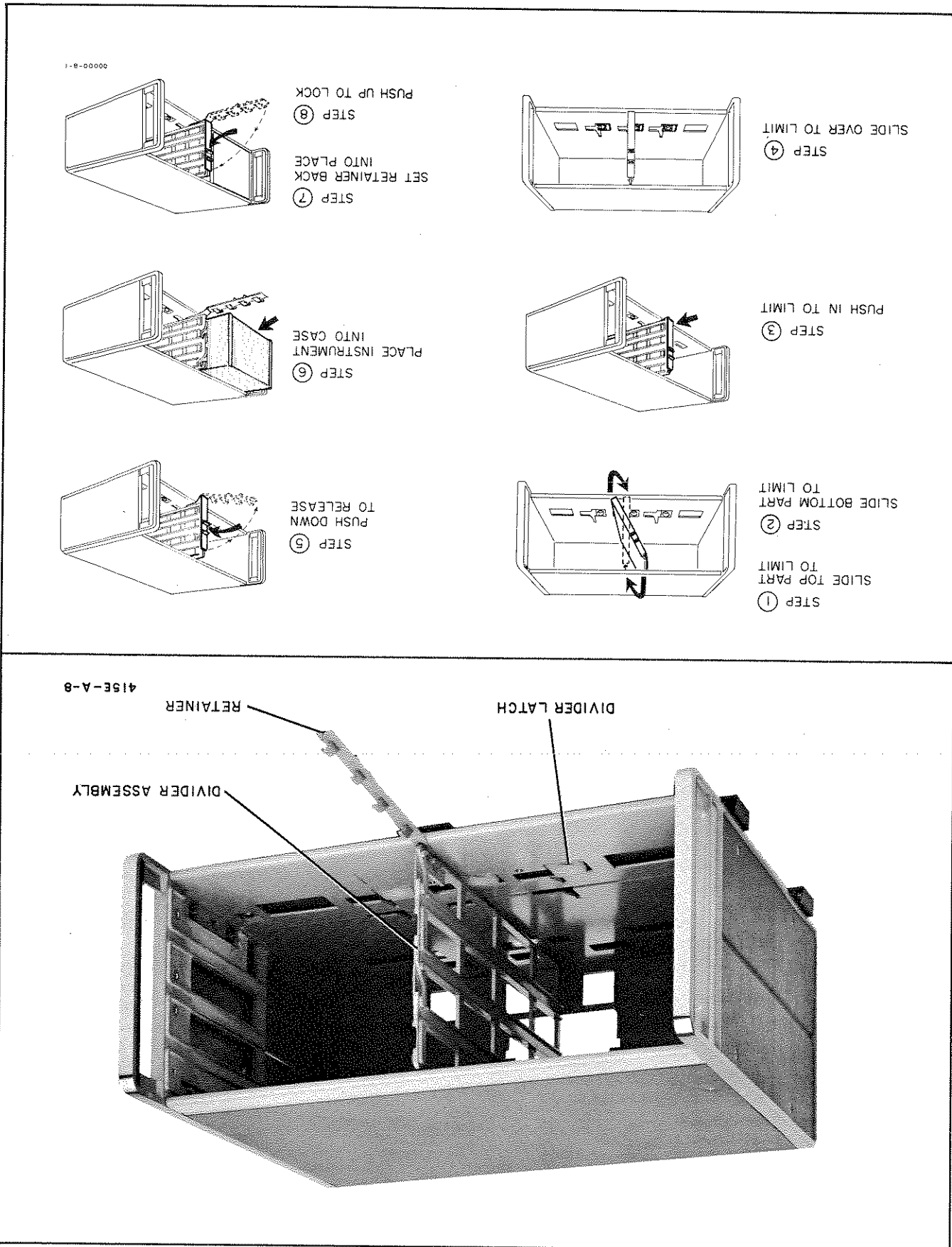
To produce sidebands approximately 20 db below the main comb marker at the 1 Gc harmonic of the appropriate comb (comb output amplitude at maximum), typical modulation voltages are:

- 1-2 mv rms at 200 kc for the 1 Mc comb
- 5-10 mv rms at 2 Mc for the 10 Mc comb
- 50-100 mv rms at 20 Mc for the 100 Mc comb

Signals greater than 5v rms at modulation input may cause damage.

<sup>2</sup>External Trigger: Typical input signal levels to generate externally triggered combs at the frequency of the external trigger are in the range of 1-3 volts rms. Input signals greater than 5 volts rms may cause damage. With input triggers in the 1-20 Mc frequency span, the OUTPUT AMPLITUDE control of the 8406A can be used to adjust the output comb level. When using signals in the frequency span from 20-200 Mc, output comb amplitude is a function of the input signal level.

Figure 2-1. Combining Case



Section II  
Figure 2-1

## SECTION II INSTALLATION

### 2-1. INTRODUCTION.

2-2. This section contains information on unpacking, inspection, repacking, storage and installation.

### 2-3. UNPACKING AND INSPECTION.

2-4. Inspect instrument for shipping damage as soon as it is unpacked. Check for broken knobs and connectors; inspect cabinet and panel surfaces for dents and scratches. A performance check is given in Table 5-2. If instrument is damaged in any way or fails to operate properly, notify carrier and your nearest Hewlett-Packard field office. For assistance of any kind, including help with instruments under warranty, contact your Hewlett-Packard field office (see list at rear of this manual).

### 2-5. STORAGE AND SHIPMENT.

2-6. PACKAGING. To protect valuable electronic equipment during storage or shipment, always use the best packaging methods available. Your Hewlett-Packard field office can provide packing material such as that used for original factory packaging. Contract packaging companies in many cities can provide dependable custom packaging on short notice. Whatever packing method is used, be sure to attach a tag to the instrument itself giving your name, address, and pertinent details.

### 2-8. RACK INSTALLATION.

2-9. When the Model 8406A is to be rack-mounted, a combining case (Paragraph 2-10) or adapter frame (Paragraph 2-11) is required. These items are available through your Hewlett-Packard field office. The two methods for rack mounting are discussed in the following paragraphs.

2-10. COMBINING CASE. The combining case (hp 1051A) shown in Figure 2-1 is a full-module unit which accepts varying combinations of submodule units such as the 1/3 module Model 8406. The combining case can be used as a bench model or it can be rack-mounted. A rack-mounting kit (hp part number 5060-0777) is supplied to rack mount the combining case. Instructions for using the case are given in Figure 2-1. When only one-third of the case is used, a blank filler panel (hp part number 5060-0793) is available to enclose the unused front panel space.

2-11. ADAPTER FRAME. The adapter frame (hp part number 5060-0797) in Figure 2-2 is a rack frame that accepts any combination of submodule units;

a. Place adapter frame on edge of bench as shown in step 1, Figure 2-2. (Only two submodule units are illustrated for clarity. The method of operation is the same for three.)

b. Stack units in frame as shown in step 2. Place spacer clamp between units, step 3.

c. Place end spacer clamps as shown in step 4, and push units into frame.  
d. Insert screws on either side of frame, step 5, and tighten until units are tight in frame.  
e. The complete assembly is now ready for rack mounting.

### 2-12. OPERATING FROM 115 OR 230 VOLTS.

2-13. The Model 8406 may be operated from either 115- or 230-volt  $\pm 10\%$ , 50- to 400-cps power lines. A slide switch on the rear panel permits quick conversion for operating from either voltage. Insert a narrow-blade screwdriver in the switch slot and slide the switch to expose "115" marking for 115-volt operation or "230" marking for 230-volt operation. A 1/16 amp fuse is used for both voltages.

CAUTION: Be sure this switch is in proper position before turning on.

2-14. POWER CABLE. The Model 8406 is equipped with a detachable 3-wire power cable. Proceed as follows for installation:

a. Connect flat plug (three-socket connector) to ac line jack at rear of instrument.

b. Connect plug (two-blade with round grounding pin) to three-wire (grounded) power outlet. Exposed portions of the instrument are grounded for safety; when only a two-blade outlet is available, use connector adapter (hp part number 1251-0048), and connect short wire from side of adapter to ground.

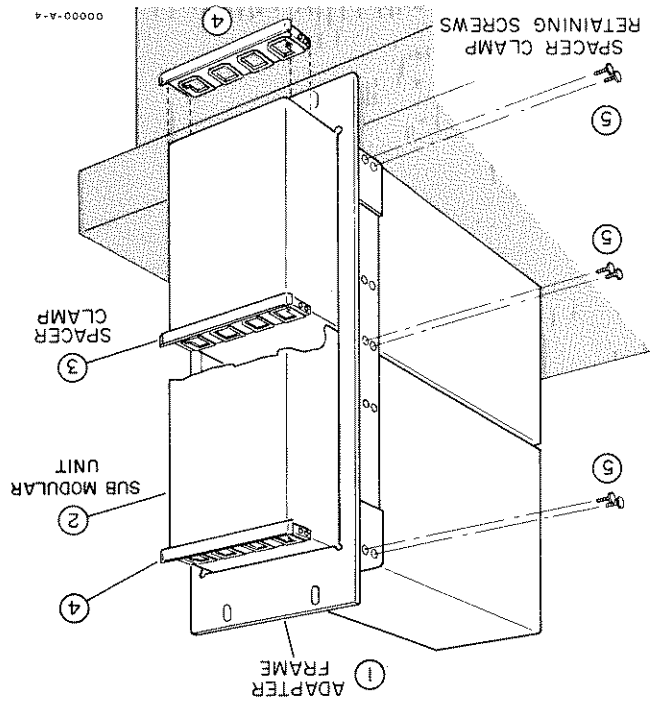
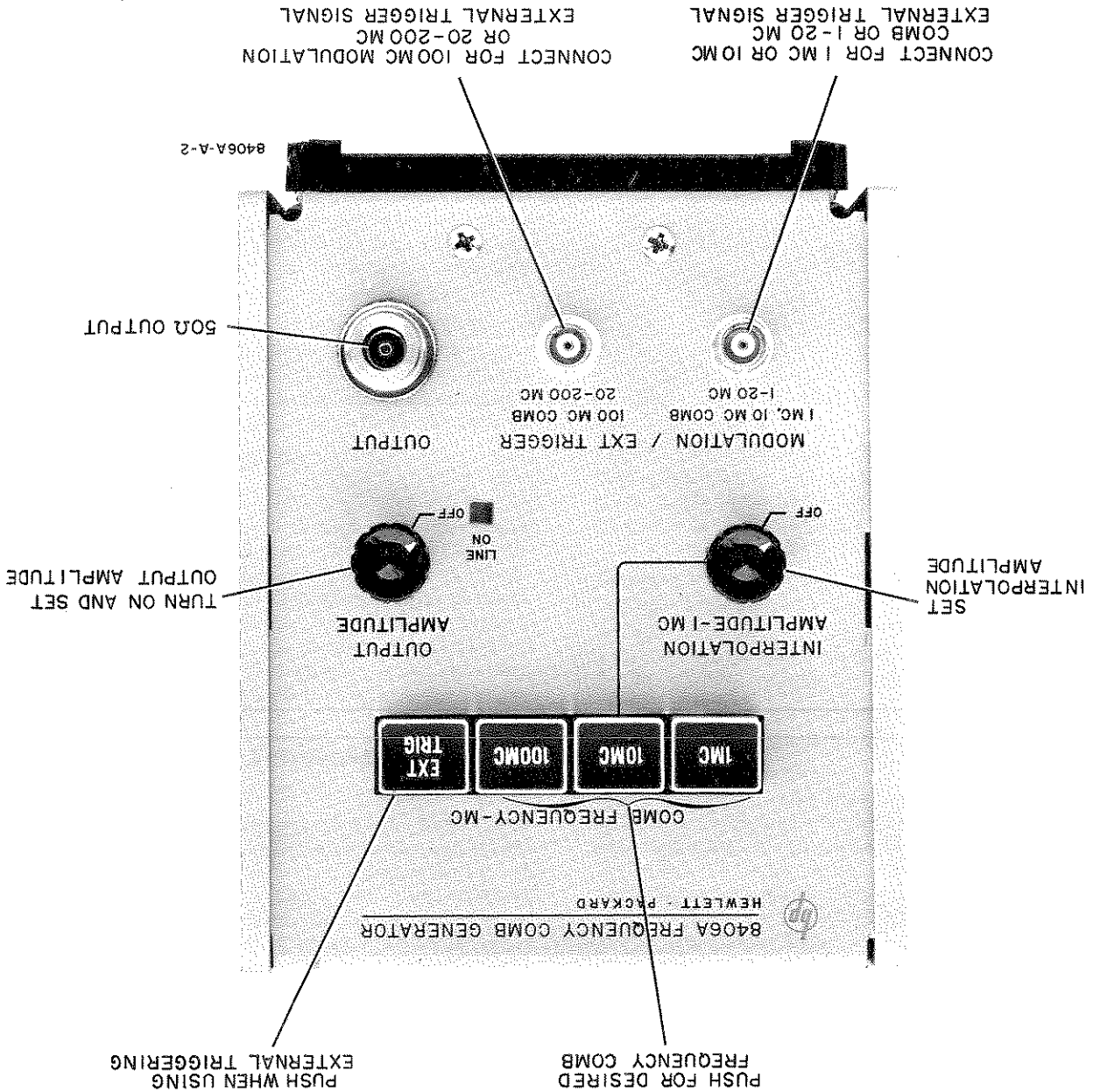


Figure 2-2. Adapter Frame

Figure 3-1. Operating Controls





### SECTION III OPERATION

#### 3-1. INTRODUCTION.

3-2. The Model 8406 Frequency Comb Generator is used to calibrate other instruments which display the frequency domain. It is usually used with Spectrum Analyzers to calibrate their frequency and output characteristics. The illustration on the facing page, Figure 3-1, shows in general the operation of the Model 8406. The following paragraphs discuss special points which are not covered in the general explanation.

3-3. INTERPOLATION MODULATION. Usually to calibrate an instrument, the 10-Mc comb is used first to determine which lines correspond to the 10-Mc markers. If a finer determination is required, the INTERPOLATION AMPLITUDE control is turned on and the amplitude adjusted. This will give ten times more lines, each marking a 1-Mc point, in addition to the 10-Mc lines. If the 1-Mc Oscillator only were used, the same accuracy would be obtained but there is the possibility that a wrong line would be chosen if the instrument being tested is badly out of calibration.

3-4. EXTERNAL MODULATION. If a modulation spectrum other than 1 Mc on the internally generated comb is desired, feed the output from an external oscillator into the appropriate MODULATION jack (1 Mc and 10 Mc or 100 Mc COMB). The level should be adjustable around 10 millivolts. Depress the COMB FREQUENCY pushbutton for the main frequency spectrum desired. The output will now contain major spectral lines spaced at the frequency of the external oscillator.

#### 4-1. GENERAL.

4-2. The Model 8406 generates a train of sharp pulses at a repetition frequency of 1 Mc, 10 Mc, or 100 Mc supplied internally or at the frequency of an external oscillator. The frequency spectrum of the output is a comb with spectral lines spaced by the repetition frequency, 1-Mc, 10-Mc, 100-Mc or the frequency of an external oscillator.

#### 4-3. BLOCK DIAGRAM.

4-4. Figure 4-1 is a block diagram which shows the inter-connections between the main sections of the instrument. Note that only one oscillator is on at any one time, except when the 1-Mc Interpolation Oscillator is used to interpolate between the main spectral lines of the 10-Mc Oscillator. In the case of the 1-Mc and 10-Mc Oscillators the signal is passed through a Diode Driver before it is applied to the Output Harmonic Generator (low-frequency signals do not generate harmonics with sufficient amplitude when applied directly to the Output Harmonic Generator). The Diode Driver

### SECTION IV THEORY OF OPERATION

#### 4-5. INDIVIDUAL CIRCUITS.

4-6. 1-MC AND 10-MC OSCILLATORS.

4-7. Since these oscillators are similar they will be described together. Both of these oscillators consist of a Colpitts-type oscillator in a common-emitter configuration. Crystal control is used in both oscillators. The output of the 1-Mc Oscillator goes directly to the Diode Driver. Output of the 1-Mc Oscillator goes either directly to the Diode Driver or to the 5-Mc Harmonic Generator Diode A1CR1. The filter following removes all harmonics above 5 Mc when the 1-Mc signal is used for interpolation between the spectral lines of the 10-Mc Oscillator. The Interpolation Oscillator phase-modulates the 10-Mc signal producing upper and lower sidebands. Line overlap would be produced if signals above 5 Mc were used for modulation. To

3-5. FREQUENCY CONSIDERATIONS. At low levels of modulation (phase modulation), a single pair of sidebands appear - variable with modulation for precise frequency determination. At higher levels of modulation more sidebands appear which permit calibration of devices (spectrum analyzers, frequency meters, etc.) in arbitrary frequency increments. As with all modulation, the absolute accuracy of the generator must be increased by the multiple of the harmonic used in order to obtain the required accuracy at the operating frequency (the percentage accuracy is the same for all harmonics).

3-6. EXTERNAL TRIGGER. The external trigger voltage is fed in by means of the EXT TRIGGER jacks, either 1-20 Mc or 20-200 Mc, depending upon frequency. The signal used for external triggering should be adjustable in amplitude around 2 volts. Note that in the EXTERNAL TRIGGER position the signal is fed into the 1-20 Mc EXT TRIGGER jack. The OUTPUT AMPLITUDE control may be used to adjust the output level when this jack is used. If the 20-200 Mc jack is used, the output level must be adjusted by varying the input level of the external trigger signal. The input from this jack does not go through the Diode Driver and therefore the OUTPUT AMPLITUDE control will have no effect. In fact, the instrument does not even have to be on if the 20-200 Mc jack is used. However, more power is needed (10-20 millivolts).

4-13. The Diode Driver generates a fast-rise pulse for each cycle sine wave fed to the tunnel diode, CR2. This fast-rise pulse produces a large current in the reverse direction of the Output Harmonic Generator, CR1. When the stored charge in the diode is depleted, the diode opens, producing a step of voltage on the transmission line of the Harmonic Generator. The Emitter Follower is used as a source of variable voltage to the Diode

**4-12. DIODE DRIVER AND EMITTER FOLLOWER.**

4-11. This Amplifier is of standard configuration with a tuned input and a tuned output. The Amplifier is energized only in the 100-Mc switch position, since it is not needed otherwise.

**4-10. 100-MC AMPLIFIER.**

4-9. This oscillator is also of the Colpitts type with a tuned tank circuit. Series tuning of the crystal is used to adjust the frequency.

**4-8. 100-MC OSCILLATOR.**

to modulate the 10-Mc signal. modulating frequencies 5 Mc or below are permitted reduce the confusion caused by two sets of signals, only

4-17. This attenuator isolates the step-recovery diode from the output connector to give a 50-ohm output impedance.

4-16. ATTENUATOR ASSEMBLY.

not have to be turned on. GER jack. For this application the instrument does

4-15. Diode CR1 is a step-recovery diode used for harmonic generation. Step-recovery diodes operate somewhat differently than normal diodes. In the forward-biased condition they act as any diode. However when back-biased, these diodes continue to conduct due to stored carriers. When the diode runs out of stored carriers it shuts off abruptly. This sharp cutoff generates a multitude of harmonics. The step function produced is formed into a impulse by the shorted transmission-line stub at the diode output. The diode must conduct in the forward direction after each pulse to replace the stored charge. A biasing network (R19, L10) sets the voltage at the diode so that conduction takes place. The step-recovery diode may be used by itself for harmonic generation. This is the situation when using the 20-200 MC EXTERNAL TRIGGER jack.

4-14. STEP-RECOVERY DIODE.

Driver. As the output of the Diode Driver is varied, the level of the output frequency comb varies.

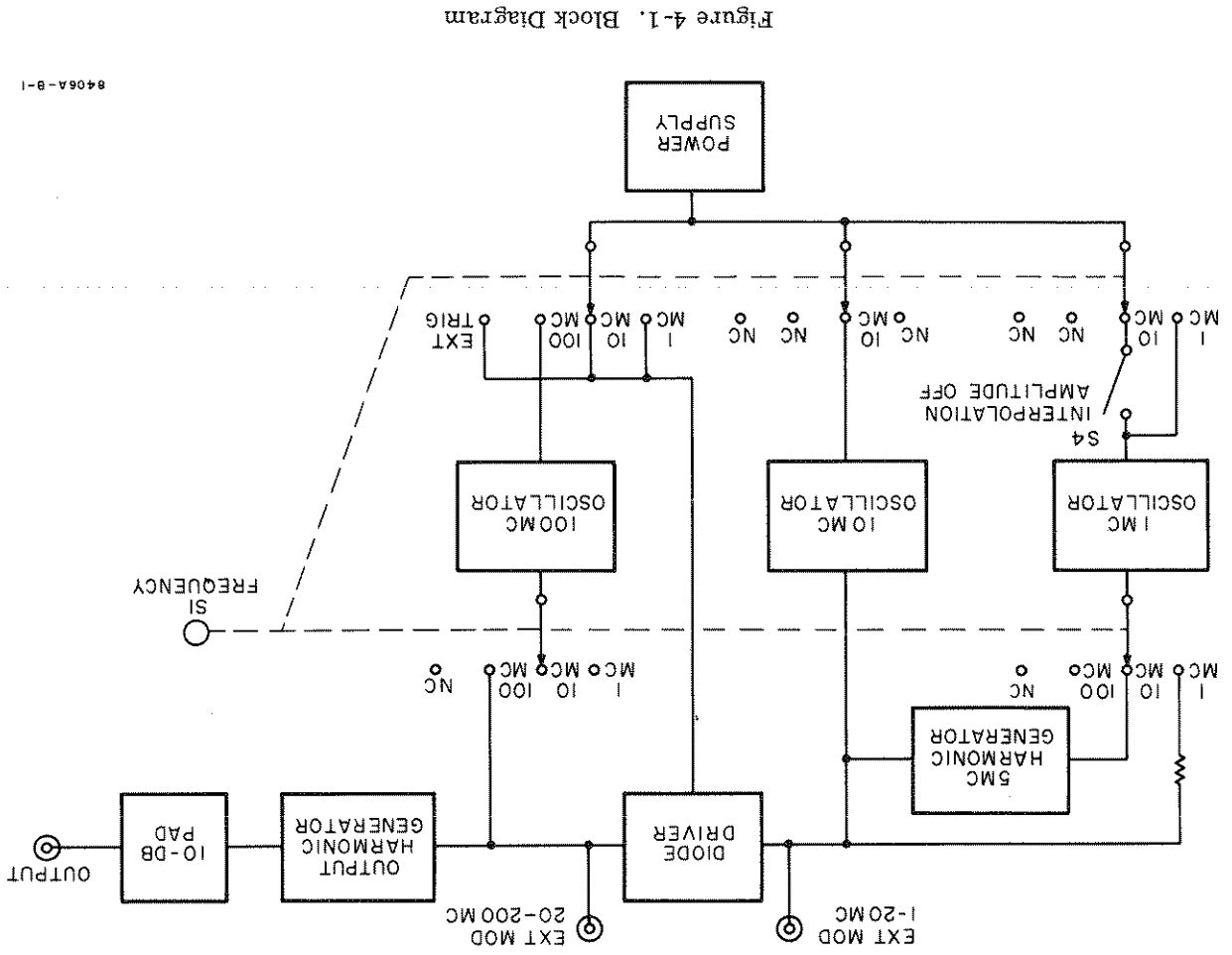


Figure 4-1. Block Diagram

8406A-8-1

## SECTION V MAINTENANCE

### 5-1. INTRODUCTION.

5-2. This section provides maintenance and service information for the Model 8406 Frequency Comb Generator. Included are a table of recommended test equipment, troubleshooting procedures, repair and adjustment procedures, and an in-cabinet performance check which may be used to verify proper operation of the Generator.

### 5-3. TEST EQUIPMENT.

5-4. Recommended test equipment for performance checking, troubleshooting, and repair is listed in Table 5-1. Other test instruments may be used if their specifications satisfy the required characteristics.

### 5-5. IN-CABINET PERFORMANCE CHECK.

5-6. GENERAL. The In-Cabinet Performance Checks, Table 5-2, and Performance Check Test Card (to be filled out during incoming inspection), verify specifications and provide a permanent record of the performance of the instrument. The In-

Cabinet Performance Check verifies the proper operation of all circuits in the Generator and may be used:

- a. As part of an incoming inspection check of instrument specifications;
- b. Periodically, for instruments used in systems where maximum reliability is of utmost importance;
- c. as part of a troubleshooting procedure to locate out-of-tolerance operation;
- d. after any repairs or adjustments, before returning instrument to regular service.

5-7. VARIABLE LINE VOLTAGE.

5-8. During the Performance Check, Table 5-2, connect the Generator to a power source through a variable voltage device so that line voltage may be varied  $\pm 10\%$  from nominal (115 or 230 Vac) to assure proper operation of the Generator under various supply conditions.

Table 5-1. Test Equipment Required

Instrument Type	Critical Specifications	Instrument Recommended
AC Voltmeter	Range: to 1 mV. Frequency Range: 40-200 cps	hp Model 400D/H/L/E/EL
DC Voltmeter	Range: 14 volts Resolution: 0.2 volts	hp Model 405BR
Electronic Counter	Range: 1 to 100 Mc Accuracy: $\pm 0.005\%$	hp Model 5254L with hp Model 5253B plug-in
Spectrum Analyzer	Range: 10 Mc - 4 Gc	hp Model 8551 with hp Model 851
Notch Filter	Rejects 2 Gc	hp Model 8439A
RF Voltmeter	Range: 100 Mc	hp Model 411A
Variable Autotransformer	Power: 1 amp Voltage: 102 to 128 volts	Ohmite VT8F
Signal Generator	Range: 200 Kc to 50 Mc	hp Model 606
Signal Generator	Frequency: 1-2 Gc	hp Model 8614A
Bandpass Filter	Pass: 2-4 Gc, reject other	hp Model 8431A
ACCESSORIES		
UG-274A/U	BNC T Connector	hp part number 1250-0072
UG-349A/U	Female N-Male BNC connector	hp part number 1250-0077
Tuning Wand		Walisco 2947
Plastic Tuning Wand		General Cement Company GC 8271

Table 5-2. In-Cabinet Performance Check

OUTPUT	
a. Connect 1-2 Gc Signal Generator to Notch Filter at the input to the Spectrum Analyzer.	<p>b. Set Spectrum Analyzer controls as follows:</p> <p>TUNE . . . . . 1 Gc (.01-2 Gc FREQUENCY range)</p> <p>IF . . . . . 2 Gc</p> <p>VERT DISPLAY . . . . . LOG</p> <p>SWEEP TIME . . . . . 1 SEC/CM</p> <p>SPECTRUM WIDTH . . . . . 200 MC/CM</p> <p>ATTENUATOR . . . . . 10 DB (to start)</p> <p>IF BANDWIDTH . . . . . 10 KC</p>
c. Set Signal Generator for -35-dBm output at 1 Gc.	<p>d. Adjust the Spectrum Analyzer for a display 6 cm high.</p> <p>e. Increase the Signal Generator frequency at approximately 200-Mc intervals to 2 Gc, observing the display amplitude at each frequency. If the amplitude changes, mark the level with a grease pencil on the face of the Spectrum Analyzer.</p>
f. Connect the 8406A as shown in Figure 5-1.	<p>NOTE: Connect counter to external modulation input corresponding to desired comb to measure frequency.</p> <p>8406A</p> <p>UG-349A/U Adapter</p> <p>8614A Mod/Trigger Check</p> <p>82538 Frequency Check</p> <p>8431A 2-4 Bandpass Filter, or 8439A 2 Gc Notch Filter</p> <p>851</p> <p>HP 360 B 517M</p>
h. Leave Spectrum Analyzer controls as in b and d. The frequency comb should be smooth in output with an output level of greater than -35 dBm from 1-2 Gc and greater than -45 dBm from 100 Mc to 1 Gc.	<p>i. Depress the 10 Mc pushbutton on the 8406.</p> <p>j. The frequency comb should be smooth in output with an output level of greater than -50 dBm from 500 Mc to 2 Gc and greater than -60 dBm from 10 Mc to 500 Mc.</p> <p>k. Depress the 1 Mc pushbutton on the 8406.</p> <p>l. The frequency comb should be smooth in output with a level of greater than -70 dBm from 500 Mc to 2 Gc and greater than -80 dBm from 10 Mc to 500 Mc (ATTENUATOR may have to be switched to 0 DB).</p> <p>m. Connect the counter and measure the frequency. Must be within 100 cycles.</p> <p>n. Depress the 10 MC pushbutton on the 8406. The frequency must be within 1000 cps.</p> <p>o. Depress the 100 MC pushbutton on the 8406. The frequency must be within 10 kc.</p> <p>p. Set the Spectrum Analyzer so that two successive 10-Mc harmonics are displayed, widely spaced.</p> <p>q. Turn the INTERPOLATION AMPLITUDE control on the 8406 fully clockwise. Ten 1-Mc pulses should appear in the space between the two 10-Mc pulses.</p>
r. Repeat Analyzer Calibration steps a-d, using a 2-4 Gc Signal Generator with a 8431A Bandpass Filter and set the Spectrum Analyzer controls as follows:	<p>IF BANDWIDTH . . . . . 10 KC</p> <p>ATTENUATOR . . . . . 10 DB (to start)</p> <p>SPECTRUM WIDTH . . . . . 200 MC/CM</p> <p>SWEEP TIME . . . . . 1 SEC/CM</p> <p>VERT DISPLAY . . . . . LOG</p> <p>IF . . . . . 200 Mc</p> <p>TUNE . . . . . 2.8/3.2 Gc (1.8-4.2 Gc FREQUENCY range)</p>
a. Repeat Analyzer Calibration steps a-d, using a 2-4 Gc Signal Generator with a 8431A Bandpass Filter and set the Spectrum Analyzer controls as follows:	<p>If it is desired to check the output level from 2-4 Gc, fundamental mixing must be used to increase sensitivity in order that the lower levels may be observed. Proceed as follows:</p>

Table 5-2. In-Cabinet Performance Check (cont'd)

<p>b. Measure 8406 comb output level, 100-Mc comb should be greater than -47 dbm over 2-4 Gc range 10-Mc comb should be greater than -62 dbm over 2-4 Gc range 1-Mc comb should be greater than -82 dbm over 2-4 Gc range (may have to reduce ATTENUATOR to 0 DB to see this sensitivity on last measurement).</p>	<p>MODULATION/EXT 1-20 MC Input</p>
<p>a. Connect the instrument as shown in Figure 5-1. b. Depress the 1 Mc pushbutton. c. Set the Spectrum Analyzer to a center frequency of 1 Gc and a spectrum width of about 3 Mc with an IF bandwidth of 1 Kc. d. Connect a Signal Generator to 1 MC, 10 MC COMB MODULATION jack on 8406. e. Set frequency of signal generator to 200 Kc and adjust output amplitude so that the sidebands displayed on Spectrum Analyzer are 20 db below the amplitude of the 1-Mc comb. f. Read the output level of the signal generator. This level should be less than 1 mV. (Actual modulating voltage required will be approximately twice this since the input impedance at this jack is high.) g. Depress the 10 MC pushbutton on the 8406. h. Set the Spectrum Analyzer to a spectrum width of 100 Mc and an IF bandwidth of 10 Kc. i. Set the frequency of signal generator to 2 Mc and level so that the sidebands displayed on spectrum analyzer are 20 db below carrier frequency. Signal Generator output level should be less than 6 mV. j. Insert a BNC T connector at the 1-20 Mc input and connect an RF Millivoltmeter to the open arm of the T to measure the input signal. k. Depress EXT TRIG pushbutton on 8406, set Signal Generator to 20 Mc and increase output level until 8406 triggers. This level should be less than 4 volts. 1-20 Trg. 4v m. Connect Signal Generator to the 100 MC COMB MODULATION jack of 8406 with the same set-up as in step k. Depress 100 MC/pushbutton on 8406, set Signal Generator to 20 Mc and increase output level until 8406 triggers. This level should be less than 200 mV.</p>	<p>o. Set Signal Generator frequency to 50 Mc, depress EXT TRIG pushbutton on 8406, and increase output level of Signal Generator until Comb Generator triggers. This level should be less than 2 volts.</p>

CAUTION

TO AVOID DAMAGE, REMOVE POWER FROM INSTRUMENT BEFORE REMOVING OR REPLACING INSTRUMENT COVERS, ASSEMBLIES, OR COMPONENTS.

5-9. INSTRUMENT COVER REMOVAL.

5-10. To remove top or bottom cover, unscrew and remove the countersunk Phillips-head screws which secure cover to the instrument at the rear. Then slide cover toward rear of instrument.

WARNING: 115/230 VAC AND DC SUPPLY WIRES ARE EXPOSED WHEN EITHER TOP OR BOTTOM INSTRUMENT COVER IS REMOVED. BE CAREFUL DURING TROUBLESHOOTING, ADJUSTMENTS, OR REPAIR.

5-11. TROUBLESHOOTING AND REPAIR.

5-12. PRELIMINARY TROUBLESHOOTING.

5-13. The first step is to decide if the trouble is catastrophic or marginal. If catastrophic, start with the power supply and then trace the signal through the in-

5-14. TRANSISTOR TROUBLESHOOTING.

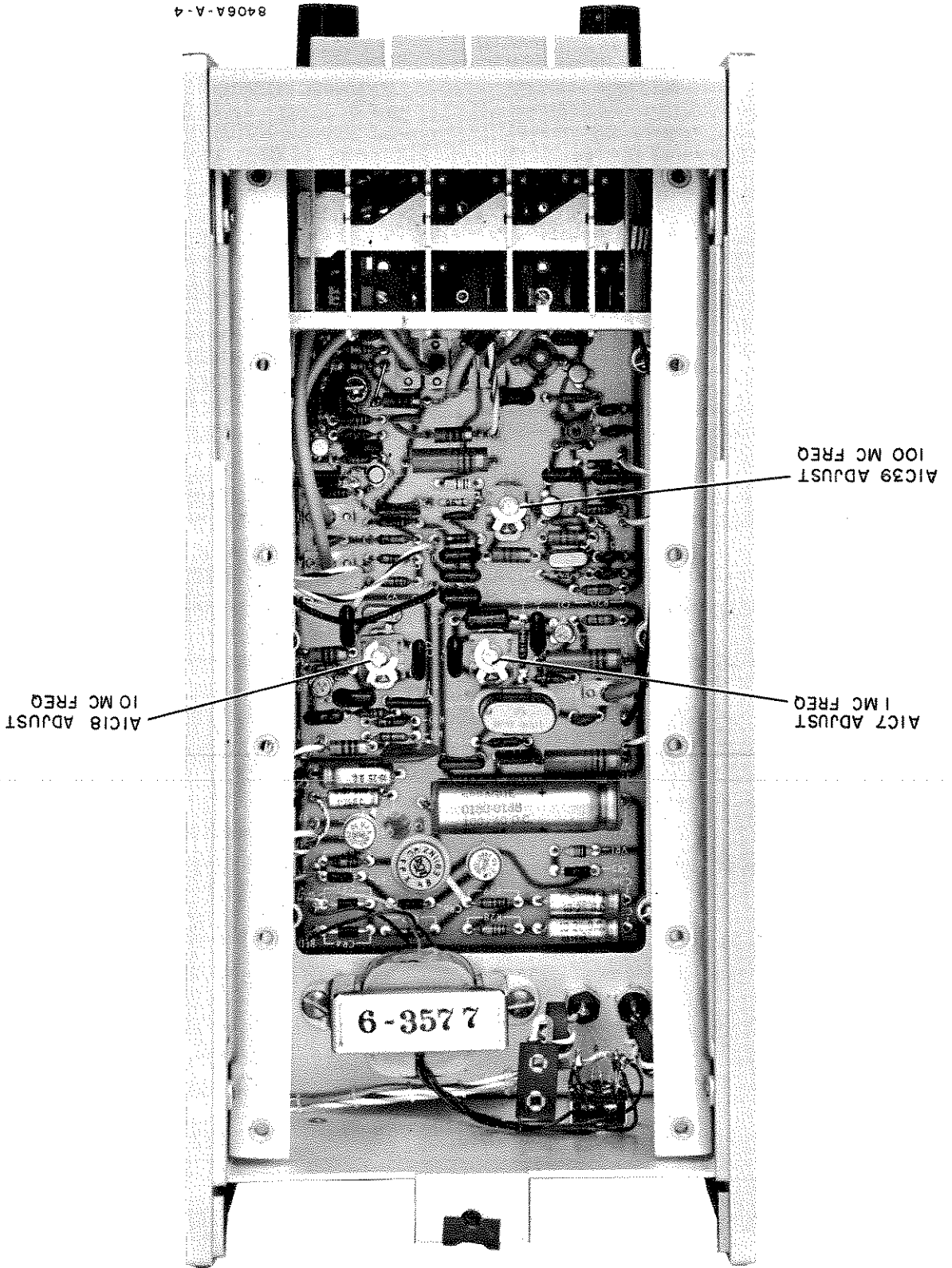
5-15. When troubleshooting transistor circuits certain precautions must be observed. Transistors can be damaged by small voltages or by heat. Be very careful not to short the circuit and thereby apply excessive voltage to the transistors. When using a VTVM measure emitter-to-base voltages to a common point, such as the chassis (there may be enough loop current between the leads of the VTVM to damage transistor). When measuring resistance use only the ranges on the ohmmeter which have 1.5 volts or less between the leads and whose short-circuit current is less than 3 mA. See Table 5-4 for the safe ranges of popular ohmmeters.

5-14. TRANSISTOR TROUBLESHOOTING.

5-15. When troubleshooting transistor circuits certain precautions must be observed. Transistors can be damaged by small voltages or by heat. Be very careful not to short the circuit and thereby apply excessive voltage to the transistors. When using a VTVM measure emitter-to-base voltages to a common point, such as the chassis (there may be enough loop current between the leads of the VTVM to damage transistor). When measuring resistance use only the ranges on the ohmmeter which have 1.5 volts or less between the leads and whose short-circuit current is less than 3 mA. See Table 5-4 for the safe ranges of popular ohmmeters.

Figure 5-2. Location Diagram

02293-1



8406A-A-4

Table 5-3. Performance Check Test Card

Description	
Output	100 Mc
Level deviation ±	db
Frequency	1 Mc
Modulation/External Trigger	
Level deviation ±	db
Frequency	10 Mc
Interpolation frequency	1-20 Mc Input
Input level	200 Kc
Input level	2 Mc
Input level	20 Mc
Input level	2-200 Mc Input
Trigger voltage	20 Mc

5-16. IN-CIRCUIT TESTING. The most common causes of transistor failures are internal short- and open-circuits. In transistor circuit testing the most important consideration is the transistor base-emitter junction. Like the control grid of a vacuum tube, the base is the control point of the transistor. The emitter-base voltage should be a fraction of a volt, the polarity and exact value depending upon the material

Table 5-4. Safe Ohmmeter Ranges for Transistor Resistance Measurements

Ohmmeter	Safe Range(s)	Voltage	Current	Color		Lead
				Short	Polarity	
HP 412A	R x 1K R x 10K R x 100K	1.0V 1.0V 1.0V	1 ma 100 µa 10 µa	Red Black Black	-	
HP 410C	R x 1K R x 10K R x 100K	1.3V 1.3V 1.3V	0.57 ma 57 µa 5.7 µa	Red Red Black	+	
HP 410B	R x 100 R x 1K R x 10K R x 100K	1.1V 1.1V 1.1V 1.1V	1.1 ma 110 µa 11 µa 0.11 µa	Black Red Red Red	+	
Simpson 260	R x 100	1.5V	1 ma	Red Black	+	
Simpson 269	R x 1K	1.5V	0.82 ma	Black Red	+	
Triplett 630	R x 100 R x 1K	1.5V 1.5V	3.25 mA 325 µA	Varies with Serial Number		
Triplett 310	R x 100	1.5V	75 µa			

of the transistor and the current carried. Short the emitter to the base. If the transistor is working, the voltage on the collector should go toward the supply voltage.

5-17. OUT-OF-CIRCUIT TESTING. While it is not recommended to remove the transistors from the instrument for troubleshooting as a general rule, sometimes it is impossible to isolate troubles to a particular transistor. In such case it may be necessary to remove the suspected transistor and test it on a curve tracer. Do NOT remove a transistor for testing without some indication that this particular transistor is at fault. Use a heat sink, such as a pair of long-nosed pliers, between the soldering iron and the transistor. When soldering a transistor back in the circuit use the same precautions as when unsoldering. If a particular transistor is all right but the circuit still does not work, try the transistor ahead and behind the suspected one. Table 5-5 gives typical resistance measurements of transistors.

5-18. PRINTED CIRCUIT COMPONENT REPLACE-MENT. Component lead holes in the Model 8406 circuit board have plated walls to ensure good electrical contact between conductors on the opposite sides of the board. To prevent damage to this plating and to the replacement component, apply heat sparingly and work carefully. The following replacement procedure is recommended:

- Remove defective component.
- Melt solder in component lead holes. Use clean, dry soldering iron to remove excess solder. Clean holes with toothpick or wooden splinter. Do not use metal tool for cleaning as this may damage through-hole plating.

Table 5-5. Output-of-Circuit Transistor Resistance Measurement

Transistor Type	Connect Ohmmeter		Resistance Measure (ohms)
	Pos. lead to	Neg. lead to	
PNP Ger-	Small emitter	base*	200-500
	Small emitter	collector	10K-100K
	Power emitter	base*	30-50
manium	Power emitter	collector	several hundred
	Small base	emitter	1K-3K
	Signal collector	emitter	very high (might read open)
Silicon	Signal collector	base	200-1000
	Power collector	emitter	high, often greater than 1M
	Power collector	emitter	

\*To test for transistor action, add collector-base short. Measured resistance should decrease.

c. Bend lead of replacement component to correct shape and insert component leads into lead holes. Using heat and solder sparingly, solder leads in place. Heat may be applied to either side of the board. Use heat sink (long-nose pliers, commercial heat-sink tweezers, etc.) when replacing transistors and diodes in order to prevent conduction of excessive heat from the soldering iron to the component. Firm application of heat for the shortest possible time is the rule.

d. Through-hole plating breaks are indicated by the separation from the board of the round conductor pad on either side of the board. To repair breaks, press conductor pads against board and solder replacement component lead to conductor pad on both sides of the board.

5-19. ADJUSTMENTS.

5-20. Rarely, if ever, will it be necessary to perform adjustments on a particular instrument. Do NOT perform these adjustments as a performance check. Use the performance check. Test limits given here should not be construed as part of the specifications.

5-21. POWER SUPPLY. Perform the following tests at either 115 or 230 volt 50-400 cps, unless otherwise noted. When line voltage variations are specified, the test limits apply at the following voltages:

115 VOLTS		230 VOLTS	
Low line	103 volts	207 volts	230 volts
Normal line	115 volts	230 volts	253 volts
High line	127 volts		

Proceed as follows:

a. Depress 10 MC COMB FREQUENCY pushbutton. Proceed as follows:

b. Set INTERPOLATION AMPLITUDE fully clockwise.

c. Set OUTPUT AMPLITUDE fully clockwise.

d. Connect a dc and an ac voltmeter to the -14 volt third terminal from the rear (see Figure 5-2 for location).

e. Vary the line voltage from low to high while watching the meters. The dc voltage should stay in regulation within 0.5 Vdc and the ac voltage (ripple) should be below 3 millivolts.

5-22. OSCILLATOR FREQUENCIES. Connect the instrument as shown in Figure 5-1. The 2 Gc Notch Filter prevents overloading of 851/851 Spectrum Analyzer at the intermediate frequency, but may not be necessary with all Spectrum Analyzers. Set Generator controls as follows:

COMB FREQUENCY . . . . . 100 MC  
 INTERPOLATION AMPLITUDE . . . . . OFF  
 OUTPUT AMPLITUDE . . . . . fully clockwise

a. Set Spectrum Analyzer to a center frequency of 1 Gc with spectrum width of 2 Gc. The frequency comb should be smooth in output. If not, tune A1T1 (see location diagram, Figure 5-2) with a Walco 2547 tuning wand for a stable frequency and A1T2 for maximum flat output in the 400-Mc region as the OUTPUT AMPLITUDE control is varied from maximum to minimum.

b. Connect counter and tune A1C39 (see location diagram, Figure 5-2) for 100-Mc frequency.

c. Depress 10 Mc pushbutton and use counter to measure frequency. Tune A1C18 with a General Cement 8271 plastic tuning wand to 10 Mc.

d. Depress 1 Mc pushbutton and use counter to measure frequency. Tune A1C7 to 1 Mc.



## SECTION VI REPLACABLE PARTS

6-3. Miscellaneous parts not indexed in Table 6-1 are listed at the end of the table.

### 6-4. ORDERING INFORMATION.

- 6-5. To order a replacement part, address order or inquiry to your nearest Hewlett-Packard field office.
- 6-6. Specify the following information for each part:
  - a. Model and complete serial number of instrument.
  - b. Hewlett-Packard stock number.
  - c. Circuit reference designation.
  - d. Description.
- 6-7. To order a part not listed in Table 6-1 and 6-2, give a complete description of the part and include its function and location.

### 6-1. INTRODUCTION.

6-2. This section contains information for ordering replacement parts. Table 6-1 lists parts in alpha-numerical order of their reference designators and indicates the description and hp stock number of each part, together with any applicable notes. Table 6-2 lists parts in alpha-numerical order of their hp stock numbers and provides the following information on each part:

- a. Description of the part (see list of abbreviations below).
- b. Typical manufacturer of the part in a five-digit code; see list of manufacturers in Table 6-3.
- c. Manufacturer's stock number.
- d. Total quantity used in the instrument (TQ column).

V	=	vacuum, tube, neon bulb, photo cell, etc.
VR	=	voltage regulator
W	=	wire
X	=	socket
Y	=	crystal
Z	=	tuned cavity, network

### REFERENCE DESIGNATORS

### ABBREVIATIONS

N/O	=	normally open
NPO	=	negative positive zero
NPN	=	negative-positive
NFRFR	=	not recommended for field replacement
NSR	=	not separately replaceable
OBD	=	order by description
OH	=	oval head
OX	=	oxide
P	=	peak
PC	=	printed circuit
PF	=	picofarads = 10 <sup>-12</sup>
PH BRZ	=	phosphor bronze
PHL	=	Phillips
PIV	=	peak inverse voltage
PNP	=	positive-negative
P/O	=	part of positive
POLY	=	polystyrene
POBRC	=	porcelain
POS	=	position(s)
POT	=	potentiometer
PP	=	peak-to-peak
PT	=	point
PWV	=	peak working voltage
RECT	=	rectifier
RF	=	radio frequency
RH	=	round head or right hand
NI PL	=	nickel plate
NE	=	neon
N/C	=	normally closed
N	=	nano (10 <sup>-9</sup> )
M	=	milli = 10 <sup>-3</sup>
M	=	micro = 10 <sup>-6</sup>
M	=	mega hertz
MFR	=	manufacturer
MET OX	=	metallic oxide
MET FILM	=	metal film
M	=	meg = 10 <sup>6</sup>
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MFR	=	manufacturer
MET OX	=	metallic oxide
MET FILM	=	metal film
M	=	meg = 10 <sup>6</sup>
M	=	milli = 10 <sup>-3</sup>
M	=	micro = 10 <sup>-6</sup>
M	=	mega hertz
MFR	=	manufacturer
MET OX	=	metallic oxide
MET FILM	=	metal film
M	=	meg = 10 <sup>6</sup>
M	=	milli = 10 <sup>-3</sup>
M	=	micro = 10 <sup>-6</sup>
M	=	mega hertz
MFR	=	manufacturer
MET OX	=	metallic oxide
MET FILM	=	metal film
M	=	meg = 10 <sup>6</sup>
M	=	milli = 10 <sup>-3</sup>
M	=	micro = 10 <sup>-6</sup>
M	=	mega hertz
MFR	=	manufacturer
MET OX	=	metallic oxide
MET FILM	=	metal film
M	=	meg = 10 <sup>6</sup>
M	=	milli = 10 <sup>-3</sup>
M	=	micro = 10 <sup>-6</sup>
M	=	mega hertz
MFR	=	manufacturer
MET OX	=	metallic oxide
MET FILM	=	metal film
M	=	meg = 10 <sup>6</sup>
M	=	milli = 10 <sup>-3</sup>
M	=	micro = 10 <sup>-6</sup>
M	=	mega hertz
MFR	=	manufacturer
MET OX	=	metallic oxide
MET FILM	=	metal film
M	=	meg = 10 <sup>6</sup>
M	=	milli = 10 <sup>-3</sup>
M	=	micro = 10 <sup>-6</sup>
M	=	mega hertz
MFR	=	manufacturer
MET OX		

Table 6-1. Reference Designation Index

Reference Designation	Stock No.	Description #	Note
A1	08406-6001	BOARD ASSY., ETCHED CIRCUIT	
A1C1	0160-0174	C:FXD CER 0.47UF +80-20% 25VDCW	
A1C2	0160-0127	C:FXD CER 1UF 20% 25VDCW	
A1C3	0160-0134	C:FXD MICA 220PF 5% 300VDCW	
A1C4	0160-0194	C:FXD MY 0.015UF 10%	
A1C5	0150-0050	C:FXD CER 1000PF 600 VDCW	
A1C6	0140-0145	C:FXD MICA 22 PF 5% 500 VDCW	
A1C7	0121-0127	C:VAR AIR 1.7-14PF	
A1C8	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW	
A1C9	0150-0093	C:FXD CER 0.01UF +80-20% 100VDCW	
A1C10	0140-0192	C:FXD MICA 68PF 5% 300VDCW	
A1C11	0160-0179	C:FXD MICA 33PF 5% 300VDCW	
A1C12	0140-0192	C:FXD MICA 68PF 5% 300VDCW	
A1C13	0150-0096	C:FXD CER 0.05UF 100VDCW	
A1C14	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW	
A1C15	0140-0204	C:FXD MICA 47PF 5% NPO 500VDCW	
A1C16	0140-0232	C:FXD MICA 460PF 1% 300VDCW	
A1C17	0160-0178	C:FXD MICA 27PF 5% 300VDCW	
A1C18	0121-0127	C:VAR AIR 1.7-14PF	
A1C19	0140-0176	C:FXD MICA 100 PF 2% 300 VDCW	
A1C20	0150-0050	C:FXD CER 1000PF 600 VDCW	
A1C21	0140-0204	C:FXD MICA 47PF 5% NPO 500VDCW	
A1C22	0150-0093	C:FXD CER 0.01UF +80-20% 100VDCW	
A1C23	0150-0121	C:FXD CER 0.1UF +80%-20% 50VDCW	
A1C24	0160-0340	C:FXD MICA 600 PF 1% 300VDCW	
A1C25	0150-0050	C:FXD CER 1000PF 600 VDCW	
A1C26	0180-0119	C:FXD ELECT 1UF -10+100% 25VDCW	
A1C27	0150-0050	C:FXD CER 1000PF 600 VDCW	
A1C28	0140-0209	C:FXD MICA 5PF 10% 500VDCW	
A1C29	0160-2197	C:FXD MICA 5PF 10% 500VDCW	
A1C30	0150-0050	C:FXD CER 1000PF 600 VDCW	
A1C31	0150-0050	C:FXD CER 1000PF 600 VDCW	
A1C32	0140-0209	C:FXD MICA 5PF 10% 500VDCW	
A1C33	0140-0232	C:FXD MICA 460PF 1% 300VDCW	
A1C34	0150-0050	C:FXD CER 1000PF 600 VDCW	
A1C35	0180-0138	C:FXD ELECT 100UF -10+100% 40VDCW	
A1C36	0180-0059	C:FXD ELECT 10UF -10%+100% 25VDCW	
A1C37	0180-0059	C:FXD ELECT 10UF -10%+100% 25VDCW	
A1C38	0180-0059	C:FXD ELECT 10UF -10%+100% 25VDCW	
A1C39	0121-0127	C:VAR AIR 1.7-14PF	
A1C40	0150-0050	C:FXD CER 1000PF 600 VDCW	
A1C41	0160-2140	C:FXD CER 470 PF +80-20% 1000VDCW	
A1C42	1912-0007	DIODE:TUNNEL EIA TYPE 1N3714	
A1C43	1901-0026	DIODE:SILICON 200 PIV 0.5 AMP	
A1C44	1901-0026	DIODE:SILICON 200 PIV 0.5 AMP	
A1C45	1901-0025	DIODE:JUNCTION:5MA AT 1V 100 PIV	
A1C46	1901-0025	DIODE:JUNCTION:5MA AT 1V 100 PIV	
A1C47	1901-0025	DIODE:JUNCTION:5MA AT 1V 100 PIV	
ALL1	9140-0131	COIL:FXD RF 10 MH	

# See list of abbreviations in introduction to this section

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Stock No.	Description #	Note
A1L2	9140-0131	COIL:FXD RF 10 MH	
A1L3	9140-0131	COIL:FXD RF 10 MH	
A1L4	9140-0181	COIL:FXD RF 22UH 5%	
A1L5	9140-0210	COIL:FXD RF 100 UH 5%	
A1L6	9140-0210	COIL:FXD RF 100 UH 5%	
A1L7	9140-0210	COIL:FXD RF 100 UH 5%	
A1L8	9140-0158	COIL:FXD 1.0UH 10%	
A1L9	9100-1612	COIL:FXD RF 0.33 UH 20%	
A1L10	9140-0210	COIL:FXD RF 100 UH 5%	
A1L11	9100-1613	COIL:FXD RF 0.47 UH 20%	
A1Q1	1854-0005	TRANSISTOR:2N708 NPN SILICON	
A1Q2	1854-0005	TRANSISTOR:2N708 NPN SILICON	
A1Q3	1850-0099	TRANSISTOR:GERMANIUM 2N964 PNP	
A1Q4	1854-0019	TRANSISTOR:SILICON NPN	
A1Q5	1854-0073	TRANSISTOR:SILICON NPN 2N3478	
A1Q6	1850-0062	TRANSISTOR:GERMANIUM PNP 2N404	
A1Q7	1854-0073	TRANSISTOR:SILICON NPN 2N3478	
A1Q8	1850-0062	TRANSISTOR:GERMANIUM PNP 2N404	
A1Q9	1850-0064	TRANSISTOR:GERMANIUM PNP 2N1183	
A1R1	0698-3156	R:F XD MET FLM 14.7K OHM 1% 1/8W	
A1R2	0757-0439	R:F XD MET FLM 6.81K OHM 1% 1/8W	
A1R3	0698-0082	R:F XD MET FLM 464 OHM 1% 1/8W	
A1R4	0698-3441	R:F XD MET FLM 215 OHM 1% 1/8W	
A1R5	0698-0083	R:F XD MET FLM 1960 OHM 1% 1/8W	
A1R6	0757-0465	R:F XD MET FLM 100K OHM 1% 1/8W	
A1R7	0698-0082	R:F XD MET FLM 464 OHM 1% 1/8W	
A1R8	0757-0280	R:F XD MET FLM 1.00K OHM 1% 1/8W	
A1R9	0698-3136	R:F XD MET FLM 17.8K OHM 1% 1/8W	
A1R10	0757-0439	R:F XD MET FLM 6.81K OHM 1% 1/8W	
A1R11	0698-0082	R:F XD MET FLM 464 OHM 1% 1/8W	
A1R12	0698-3441	R:F XD MET FLM 215 OHM 1% 1/8W	
A1R13	0698-0084	R:F XD MET FLM 2150 OHM 1% 1/8W	
A1R14	0698-0084	R:F XD MET FLM 2150 OHM 1% 1/8W	
A1R15	0757-0280	R:F XD MET FLM 1.00K OHM 1% 1/8W	
A1R16	0757-1094	R:F XD MET FLM 1.47K OHM 1% 1/8W	
A1R17	0757-0401	R:F XD MET FLM 100 OHM 1% 1/8W	
A1R18	0698-3441	R:F XD MET FLM 215 OHM 1% 1/8W	
A1R19	0757-0401	R:F XD MET FLM 100 OHM 1% 1/8W	
A1R20	0757-0441	R:F XD MET FLM 8.25K OHM 1% 1/8W	
A1R21	0698-3154	R:F XD MET FLM 4220 OHM 1% 1/8	
A1R22	0757-0417	R:F XD MET FLM 562 OHM 1% 1/8W	
A1R23	0698-3440	R:F XD MET FLM 196 OHM 1% 1/8W	
A1R24	0698-3441	R:F XD MET FLM 215 OHM 1% 1/8W	
A1R25	0698-3430	R:F XD MET FLM 21.5 OHM 1% 1/8W	
A1R26	0698-3430	R:F XD MET FLM 21.5 OHM 1% 1/8W	
A1R27	0757-0346	R:F XD MET FLM 10.0 OHM 1% 1/8W	
A1R28	0698-0084	R:F XD MET FLM 2150 OHM 1% 1/8W	
A1R29	0698-0084	R:F XD MET FLM 2150 OHM 1% 1/8W	
A1R30	0757-0346	R:F XD MET FLM 10.0 OHM 1% 1/8W	
A1R31	0698-3445	R:F XD MET FLM 348 OHM 1% 1/8W	
A1R32	0757-0416	R:F XD MET FLM 511 OHM 1% 1/8W	
A1T1	08406-6013	TRANSFORMER:RF (OSCILLATOR)	

# See list of abbreviations in introduction to this section

# See list of abbreviations in introduction to this section

Reference Designation	Stock No.	Description #	Note
A1T2	08406-6014	TRANSFORMER:RF (AMPLIFIER)	
A1V1	1902-0055	DIODE BREAKDOWN:SILICON 14.7V 10%	
A1X1	1200-0028	SOCKET:CRYSTAL 2-CONTACT	
A1Y1	0410-0013	CRYSTAL UNIT:QUARTZ 100KC	
A1Y2	0410-0109	CRYSTAL:QUARTZ 10 MC	
A1Y3	0410-0108	CRYSTAL:QUARTZ 100 MC	
C1	0150-0097	C:FXD CER 6800 PF 1000 VDCW	
C2	0150-0019	C:FXD CER 1000PF 20%	
C3	0150-0019	C:FXD CER 1000PF 20%	
C4	0150-0097	C:FXD CER 6800 PF 1000 VDCW	
CR1	1901-0169	SEMICON DEVICE: DIODE	
CR1MP1	08406-6002	HOLDER ASSEMBLY, DIODE INCLUDES:	
	1250-0014	CONTACT: OUTER N MALE CONNECTOR	
	1250-0016	RING: LOCKING FOR TYPE N CONNECTOR	
	5020-0306	NUT: CONNECTOR	
	08406-2002	BODY, DIODE HOLDER	
	08406-2003	CENTER CONDUCTOR	
	08406-2005	SPACER	
	08551-2041	POST, DIODE	
CR1MP2	1460-0300	SPRING: COMPRESSION	
DS1	2140-0047	LAMP:GLOW 1/10W 0.8 MA 68K OHM	
F1	2110-0040	FUSE:CARTRIDGE 1/16 AMP SLOW BLOW	
J1	1250-0001	CONNECTOR:BNC	
J2	1250-0001	CONNECTOR:BNC	
J3	1251-0148	CONNECTOR:POWER 3 PIN MALE	
J4	08406-2004	NSR PART OF STEP DIODE ASSY.	
J5	08406-2004	CONNECTOR: PANEL	
L1	9170-0019	CORE:TOROID	
L2	9170-0019	CORE:TOROID	
P1	2100-0360	NSR PART OF ATTENUATOR ASSY	
R1	2100-0360	R:VAR COMP 1.5K OHM 20% LIN 1/2W	
R2	0687-6831	R:FXD COMP 68K OHM 10% 1/2W	
R3	2100-0350	R:VAR COMP 1500 OHM 20% LIN 1/2W	
S1	3101-0186	SWITCH:PUSHBUTTON(FREQUENCY)	
S2	3101-0033	SWITCH:SLIDE DPDT	
S3	3101-1248	SWITCH:PUSHBUTTON (LINE)	
S4	115V-230V	NSR PART OF R3	
T1	9100-1680	TRANSFORMER:POWER	
XF1	1400-0084	HOLDER:FUSE POST TYPE 3AG	
Z1	08406-6012	ATTENUATOR PAD ASSEMBLY INCLUDES:	
	1460-0297	SPRING:COMPRESSION	
	08491-6000	CARTRIDGE ASSEMBLY	
	08491-2101	CONNECTOR:FEMALE	
	08491-2102	SPACER (QTY 2)	

Table 6-1. Reference Designation Index (Cont'd)

Table 6-1. Reference Designation Index (Cont'd)

Reference Designation	Stock No.	Description #	Note
08742-0006		SPACER	
08491-2002		BEAD	
08491-4001		PIN, FEMALE	
08491-2009		CONTACT, SLIDING	
MISCELLANEOUS			
08406-0003		BRACKET, BOTTOM COVER	
08406-0004		BRACKET, RIGHT SUPPORT	
08406-0005		BRACKET, LEFT SUPPORT	
08406-0006		BRACKET, SWITCH	
08406-6004		CABLE ASSY., COAX(ORANGE)	
08406-6005		CABLE ASSY., COAX(RED)	
08406-6006		CABLE ASSY., COAX(BROWN)	
08406-6007		CABLE ASSY., COAX(BLACK)	
08406-6009		CABLE ASSY., COAX(YELLOW)	
08406-6010		CABLE ASSY., COAX(GREEN)	
08406-6011		CABLE ASSY., COAX(BLUE)	
8120-0078		CABLE ASSY:POWER	
5040-0235		BASE/LAMPHOLDER	
5040-0234		LAMPHOLDER	
0370-0118		KNOB/GRAY PUSHBUTTON 11/16 IN DIA	
		1MC	
		10MC	
		100MC	
		EXT TRIG	
5000-3227		LABEL:PUSHBUTTON (1 MC)	
5000-3228		LABEL:PUSHBUTTON(10 MC)	
5000-3229		LABEL:PUSHBUTTON(100 MC)	
5000-3248		LABEL:PUSHBUTTON(EXT. TRIG)	
08406-0001		SUPPORT, LEFT	
08406-0002		SUPPORT, RIGHT	
0370-0103		KNOB:BLACK ROUND	
		OUTPUT AMPLITUDE	
		INTERPOLATION AMPLITUDE 1MC	

# See list of abbreviations in introduction to this section

# See list of abbreviations in introduction to this section

Reference Designation	Stock No.	Description #	Note
1	5060-0703	FRAME ASSEMBLY	
2	1490-0031	STAND: TILT	
3	5040-0700	HINGE	
4	5060-0727	FOOT ASSEMBLY	
5	5020-0700	SPACER	
6	5000-0703	COVER: SIDE	
7	5060-0709	COVER ASSEMBLY: TOP	
8	5000-0711	COVER ASSEMBLY: BOTTOM	
9	5000-0714	COVER ASSEMBLY: UNPERFORATED	
10	SEE MAT'L LIST	PANEL: REAR	
	SEE MAT'L LIST	PANEL: FRONT	

CABINET PARTS

MODULE  
SIZE 29

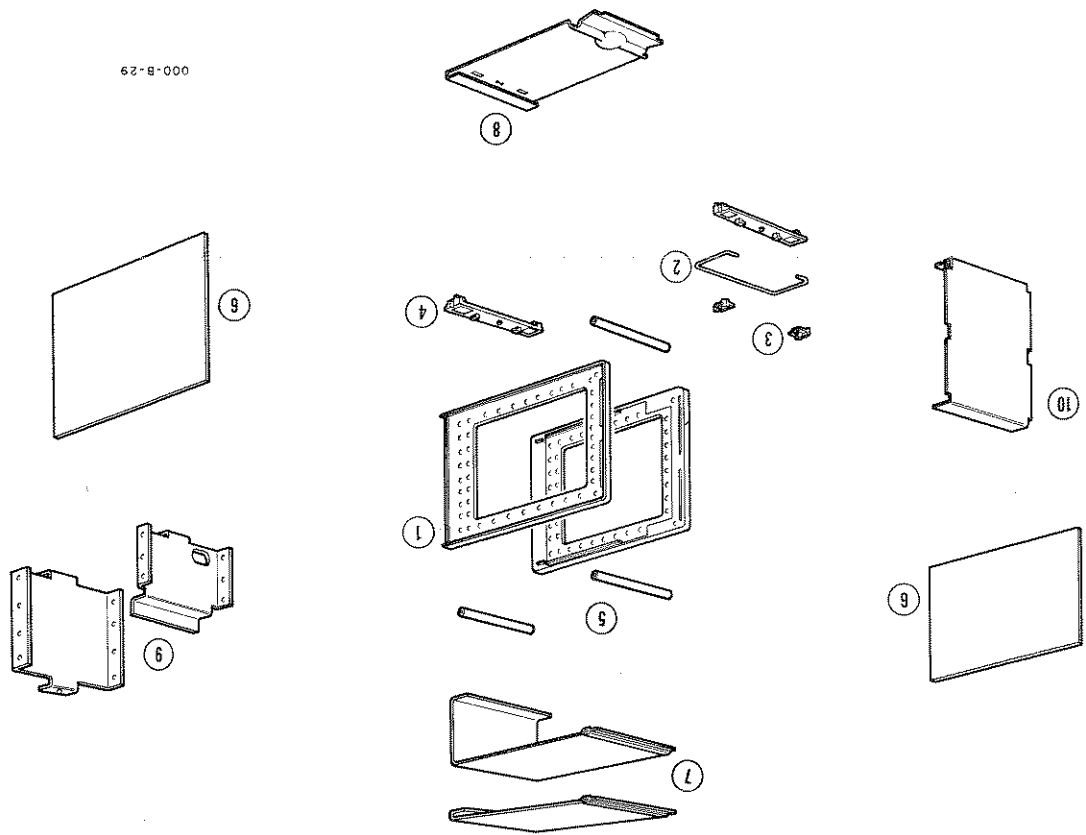


Table 6-1. Reference Designation Index (Cont'd)

Table 6-2. Replaceable Parts (Cont'd)

Stock No.	Description #	Mfr.	Mfr. Part No.	TQ
0121-0127	CVAR AIR 1.7-14PF	28480	0121-0127	3
0140-0145	CIFXD MICA 22 PF 5% 500 VDCW	04062	RDMS15C220J5C	1
0140-0176	CIFXD MICA 100 PF 2% 300 VDCW	04062	RDMS15F101G3C	1
0140-0192	CIFXD MICA 68PF 5% 300VDCW	04062	RDMS15E680J3C	2
0140-0204	CIFXD MICA 47PF 5% NP0 500VDCW	04062	RDMS15E470J5C	2
0140-0209	CIFXD MICA 5PF 10% 500VDCW	04062	RDMS15C050D5C	2
0140-0232	CIFXD MICA 460PF 1% 300VDCW	04062	RDMS15F461F3C	2
0150-0019	CIFXD CER 1000PF 20%	72982	327005X5U0102M	2
0150-0050	CIFXD CER 1000PF 600 VDCW	84411	TYPE E	2
0150-0093	CIFXD CER 0.01UF +80-20% 100VDCW	91418	TA	8
0150-0096	CIFXD CER 0.05UF 100VDCW	91418	-TA	1
0150-0097	CIFXD CER 6800 PF 1000 VDCW	91418	B	2
0150-0121	CIFXD CER 0.1UF +80%-20% 50VDCW	56289	5C50A	3
0160-0127	CIFXD CER 1UF 20% 25VDCW	56289	5C13	1
0160-0134	CIFXD MICA 220PF 5% 300VDCW	14655	RDMS15F221J3C	1
0160-0174	CIFXD CER 0.47UF +80-20% 25VDCW	56289	5C11A	1
0160-0178	CIFXD MICA 27PF 5% 300VDCW	04062	RDMS15E270J35	1
0160-0179	CIFXD MICA 33PF 5% 300VDCW	04062	RDMS15E330J35	1
0160-0194	CIFXD MY 0.015UF 10%	28480	0160-0194	1
0160-0340	CIFXD MICA 600 PF 1% 300VDCW	04062	RDMS15F601F3C	1
0160-2140	CIFXD CER 470 PF +80-20% 1000VDCW	91418	TYPE B	1
0160-2197	CIFXD MICA 10PF 5%	28480	0160-2197	3
0180-0059	CIFXD ELECT 10UF -10%+100% 25VDCW	56289	30D1066025B844	1
0180-0119	CIFXD ELECT 1UF -10%+100% 25VDCW	56289	30D1056025A44	1
0180-0138	CIFXD ELECT 100UF -10+100% 40VDCW	56289	036254	1
0370-0103	KNOB:BLACK ROUND	28480	0370-0103	2
0370-0118	KNOB:GRAY PUSHBUTTON 11/16" DIA	28480	0370-0118	4
0410-0013	CRYSTAL UNIT:QUARTZ 100KC	28480	0410-0013	1
0410-0108	CRYSTAL:QUARTZ 100 MC	28480	0410-0108	1
0410-0109	CRYSTAL:QUARTZ 10 MC	28480	0410-0109	1
0687-6831	RIFXD COMP 68K OHM 10% 1/2W	01121	EB-6831	3
0698-0082	RIFXD MET FLM 464 OHM 1% 1/8W	28480	0698-0082	1
0698-0083	R:FXD MET FLM 1960 OHM 1% 1/8W	28480	0698-0083	3
0698-0084	RIFXD MET FLM 2150 OHM 1% 1/8W	28480	0698-0084	4
0698-2136	RIFXD MET FLM 17.8KOHM 1% 1/8W	28480	0698-2136	1
0698-2154	RIFXD MET FLM 4220 OHM 1% 1/8W	28480	0698-2154	1
0698-2156	RIFXD MET FLM 14.7KOHM 1% 1/8W	28480	0698-2156	1
0698-2430	RIFXD MET FLM 21.5 OHM 1% 1/8W	28480	0698-2430	1
0698-2470	R:FXD MET FLM 196 OHM 1% 1/8W	28480	0698-2470	2
0698-3441	RIFXD MET FLM 215 OHM 1% 1/8W	28480	0698-3441	4
0698-3445	RIFXD MET FLM 348 OHM 1% 1/8W	28480	0698-3445	1
0757-0280	RIFXD MET FLM 1.0KOHM 1% 1/8W	28480	0757-0280	2
0757-0246	RIFXD MET FLM 10.0 OHM 1% 1/8W	28480	0757-0246	2
0757-0401	RIFXD MET FLM 100 OHM 1% 1/8W	28480	0757-0401	2
0757-0416	R:FXD MET FLM 511 OHM 1% 1/8W	28480	0757-0416	1
0757-0417	RIFXD MET FLM 562 OHM 1% 1/8W	28480	0757-0417	1
0757-0439	RIFXD MET FLM 6.81K OHM 1% 1/8W	28480	0757-0439	2
0757-0441	RIFXD MET FLM 8.25KOHM 1% 1/8W	28480	0757-0441	1
0757-1094	RIFXD MET FLM 1.47K OHM 1% 1/8W	28480	0757-1094	1
1200-0028	SOCKET:CRYSTAL 2-CONTACT	91662	430 BC	1
1250-0014	CONTACT:OUTER N MALE CONNECTOR	28480	1250-0014	1
1250-0016	RING:LOCKING FOR TYPE N CONNECTOR	28480	1250-0016	1
1250-0083	CONNECTOR:BNB	28480	1250-0083	2
1251-0148	CONNECTOR:POWER 3 PIN MALE	60427	H-1061-2	1
1400-0084	HOLDER:FUSE POST TYPE 3AG	75915	342014	1

# See list of abbreviations in introduction to this section

# See list of abbreviations in introduction to this section

Stock No.	Description #	Mfr.	Mfr. Part No.	TQ
1460-0297	SPRING:COMPRESSION	28480	1460-0297	2
1490-0031	STAND:TILT	28480	1490-0031	2
1850-0062	TRANSISTOR:GERMANIUM PNP 2N404	28480	1850-0062	2
1850-0064	TRANSISTOR:GERMANIUM PNP 2N1183	02735	2N1183	1
1850-0099	TRANSISTOR:GERMANIUM 2N964 PNP	04713	2N964	1
1854-0005	TRANSISTOR:2N708 NPN SILICON	07263	2N708	2
1854-0019	TRANSISTOR:SILICON NPN	28480	1854-0019	1
1854-0075	TRANSISTOR:SILICON NPN 2N3478	93332	2N3478	2
1901-0025	DIODE:JUNCTION:5MA AT 1V 100 PIV	28480	1901-0025	2
1901-0026	DIODE:SILICON 200 PIV 0.5 AMP	28480	1901-0026	2
1901-0040	DIODE:SILICON 30 MA AT 1V 30 PIV	28480	1901-0040	1
1901-0169	SEMICON DEVICE:DIODE	28480	1901-0169	1
1902-0055	DIODE BREAKDOWN:SILICON 14.7V 10%	28480	1902-0055	1
1912-0007	DIODE:TUNNEL EIA TYPE 1N3714	03508	1N3714 SPEC	1
2100-0350	RIVAR COMP 1500 OHM 20% LIN 1/2W	28480	2100-0350	1
2100-1624	RIVAR COMP 2.5K OHM 20% LIN 1/2W	28480	2100-1624	1
2110-0040	FUSE:CARTRIDGE 1/16 AMP SLOW BLOW	75915	313.062	1
2140-0047	LAMP:GLOW 1/10W 0.8 MA 68K OHM	24455	A1C	1
3101-0033	SWITCH:SLIDE DPDT	42190	4633	1
3101-0186	SWITCH:PUSHBUTTON(FREQUENCY)	28480	3101-0186	1
5000-0011	CLIP:ELECTRICAL RETAINING	28480	5000-0011	1
5000-3227	LABEL:PUSHBUTTON (1 MC)	28480	5000-3227	1
5000-3228	LABEL:PUSHBUTTON(10 MC)	28480	5000-3228	1
5000-3229	LABEL:PUSHBUTTON(100 MC)	28480	5000-3229	1
5000-3248	LABEL:PUSHBUTTON(EXT. TRIG)	28480	5000-3248	1
5020-0306	NUT:CONNECTOR	28480	5020-0306	1
5040-0234	LAMPHOLDER(FOR 4 LAMPS)	28480	5040-0234	1
5040-0235	BASE:LAMPHOLDER	28480	5040-0235	1
5040-0700	HINGE	28480	5040-0700	1
5060-0703	COVER:6 X 11 SIDE	28480	5060-0703	1
5060-0709	COVER ASSY:TOP 5 X 11 SM	28480	5060-0709	1
8120-0078	CABLE ASSY:POWER	70903	KH-4147	1
9100-1612	COIL:FWD RF 0.33 UH 20%	28480	9100-1612	1
9100-1678	TRANSFORMER:OSCILLATOR	28480	9100-1678	1
9100-1679	TRANSFORMER:RF AMPL	28480	9100-1679	1
9100-1613	COIL:FWD RF 0.47 UH 20%	28480	9100-1613	1
9100-1680	TRANSFORMER:POWER	28480	9100-1680	1
9140-0131	COIL:FWD RF TO MH	28480	9140-0131	1
9140-0158	COIL:FWD 1.0UH 10%	28480	9140-0158	1
9140-0181	COIL:FWD RF 22UH 5%	75226	12201M	1
9140-0210	COIL:FWD RF 100 UH 5%	28480	9140-0210	4
9170-0019	CORE:TOROID	72656	CF104 Q-1	2
08406-0001	SUPPORT: LEFT	28480	08406-0001	1
08406-0002	SUPPORT: RIGHT	28480	08406-0002	1
08406-0003	BRACKET: BOTTOM COVER	28480	08406-0003	1
08406-0004	BRACKET: RIGHT SUPPORT	28480	08406-0004	1
08406-0005	BRACKET: LEFT SUPPORT	28480	08406-0005	1
08406-0006	BRACKET: SWITCH	28480	08406-0006	1
08406-0007	COVER: TOP	28480	08406-0007	1
08406-0008	COVER: BOTTOM	28480	08406-0008	1
08406-0009	PANEL: REAR	28480	08406-0009	1

Table 6-2. Replaceable Parts (Cont'd)



Table 6-2. Replaceable Parts (Cont'd)

Stock No.	Description #	Mtr.	Mtr. Part No.	TQ
08406-0010	PANEL, FRONT	28480	08406-0010	1
08406-0011	CHASSIS	28480	08406-0011	1
08406-2002	BODY, DIODE HOLDER	28480	08406-2002	1
08406-2003	CENTER CONDUCTOR	28480	08406-2003	1
08406-2004	CONNECTOR, PANEL	28480	08406-2004	1
08406-2104	CONNECTOR, PANEL	28480	08406-2104	1
08406-6001	BOARD ASSY., ETCHED CIRCUIT	28480	08406-6001	1
08406-6002	HOLDER ASSEMBLY, DIODE	28480	08406-6002	1
08406-6004	CABLE ASSY., COAX (ORANGE)	28480	08406-6004	1
08406-6005	CABLE ASSY., COAX (RED)	28480	08406-6005	1
08406-6006	CABLE ASSY., COAX (BROWN)	28480	08406-6006	1
08406-6007	CABLE ASSY., COAX (BLACK)	28480	08406-6007	1
08406-6009	CABLE ASSY., COAX (YELLOW)	28480	08406-6009	1
08406-6010	CABLE ASSY., COAX (GREEN)	28480	08406-6010	1
08406-6011	CABLE ASSY., COAX (BLUE)	28480	08406-6011	1
08406-6012	ATTENUATOR PAD ASSEMBLY	28480	08406-6012	1
08491-2101	CONNECTOR, FEMALE	28480	08491-2101	1
08491-2002	BEAD	28480	08491-2002	2
08491-2004	PIN, FEMALE	28480	08491-2004	2
08491-2005	CONTACT, SLIDING	28480	08491-2005	2
08491-6000	CARTRIDGE ASSEMBLY	28480	08491-6000	1
08551-2041	POST, DIODE	28480	08551-2041	1
08742-0006	SPACER	28480	08742-0006	1
5000-0703	COVER, SIDE 6X11 SM	28480	5000-0703	2
5000-0711	COVER, BOTTOM 5X11 SM	28480	5000-0711	1
5060-0727	FOOT ASSY, 1/3 MOD	28480	5060-0727	1

# See list of abbreviations in introduction to this section

TABLE 6-3. CODE LIST OF MANUFACTURERS

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1 (Name to Code) and H4-2 (Code to Name) and their latest supplements. The date of revision and the date of the supplements used appear at the bottom of each page. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 Handbooks.

Table with 4 columns: Code No., Manufacturer, Address, and Code No. Manufacturer, Address. It lists various electronic manufacturers such as Aiken Products Co., Allen Bradley Co., and Amperon-Borg Electronics Corp. with their respective addresses and codes.



Code	Manufacturer	Address	Code	Manufacturer	Address
82866	Research Products Corp.	Madison, Wis.	91345	Milner Dial & Rameplate Co.	El Monte, Calif.
82877	Roton Mfg. Co., Inc.	Woodstock, N.Y.	91448	Radio Materials Co.	Chicago, Ill.
82893	Vector Electronic Co.	Glendale, Calif.	91506	Argal Inc.	Atteborro, Mass.
83053	Western Washer Mfg. Co.	Los Angeles, Calif.	91637	Date Electronics, Inc.	Columbus, Neb.
83058	Carr Fastener Co.	Cambridge, Mass.	91662	Eico Corp.	Willow Grove, Pa.
83086	New Hampshire Ball Bearing, Inc.	Peterborough, N.H.	91737	Gemmer Mfg. Co., Inc.	Wakefield, Mass.
83125	General Instrument Corp., Capacitor Div.	Dartington, S.C.	91827	K F Development Co.	Redwood City, Calif.
83148	ITT Wire and Cable Div.	Los Angeles, Calif.	91866	Honeywell Inc., Micro Switch Div.	Chicago, Ill.
83186	Victory Eng. Corp.	Springfield, N.J.	91929	Micro Switch Div.	Chicago, Ill.
83298	Bonix Corp., Red Bank Div.	Red Bank, N.J.	92180	Tu-Con Connector Corp.	Peabody, Mass.
83315	Hubble Corp.	Mundelein, Ill.	92196	Universal Industries, Inc.	City of Industry, Calif.
83330	Smith, Herman H., Inc.	Brooklyn, N.Y.	92207	Tensolite Insulated Wire Co., Inc.	Tarrytown, N.Y.
83385	Central Screw Co.	Chicago, Ill.	92702	IMC Magnetics Corp.	Wesbury Long Island, N.Y.
83501	Gavitt Wire and Cable Co.	Brookfield, Mass.	92966	Hudson Lamp Co.	Kearney, N.J.
83594	Burrells Corp., Electronic Tube Div.	Brookfield, Mass.	93332	Sylvania Electric Prod. Inc.	Woburn, Mass.
83740	Union Carbide Corp., Consumer Prod. Div.	Plainfield, N.J.	93369	Robbins and Myers, Inc.	New York, N.Y.
83772	Model Eng. and Mfg., Inc.	Huntington, Ind.	93410	Stevens Mfg. Co., Inc.	Mansfield, Ohio
83821	Lloyd Scruggs Co.	Festus, Mo.	93929	G.V. Controls	Livingston, N.J.
83942	Aeronautical Inst. & Radio Co.	Leoti, N.J.	94144	Raytheon Co., Comp. Div., Ind.	Bayonne, N.J.
84171	Arco Electronics Inc.	Great Neck, N.Y.	94148	Scientific Electronics Products, Inc.	Quincy, Mass.
84196	A. J. Giesener Co., Inc.	San Francisco, Calif.	94154	Tung-Sol Electric, Inc.	Newark, N.J.
84411	TRW Capacitor Div.	Galatita, Neb.	94197	Curtiss-Wright Corp., Electronics Div.	East Rutherford, N.J.
84544	Bonham Molding Company	Bloomington, Ind.	94222	South Chester Corp.	West Chester, Ohio
84571	R. M. Bracamonte & Co.	San Francisco, Calif.	94310	Tu-Ohm Products Memcor Components Div.	Huntington, Ind.
84574	A. B. Boyd Co.	Hamden, Conn.	94330	Wire Cloth Products, Inc.	Bellwood, Ill.
84591	Seamless Rubber Co.	Chicago, Ill.	94682	Worcester Pressed Aluminum Corp.	Worcester, Mass.
84639	A. J. Giesener Co., Inc.	San Francisco, Calif.	94696	Magnecraft Electric Co.	Chicago, Ill.
84696	Arco Electronics Inc.	Great Neck, N.Y.	95023	George A. Philbrick Researchers, Inc.	Boston, Mass.
84721	Arco Electronics Inc.	Great Neck, N.Y.	95236	Allies Products Corp.	Miami, Fla.
84744	Arco Electronics Inc.	Great Neck, N.Y.	95238	Continental Connector Corp.	Woodside, N.Y.
84772	Western Fibrous Glass Products Co.	Lansdale, Pa.	95265	National Coil Co.	Sheridan, Wyo.
84821	Federal Telephone & Radio Corp.	Clifton, N.J.	95264	Lerco Electronics, Inc.	Burbank, Calif.
84822	Gold-National Batteries, Inc.	St. Paul, Minn.	95275	Vitamin, Inc.	Bridgport, Conn.
84842	Federal Telephone & Radio Corp.	Clifton, N.J.	95348	Gordex Corp.	Bloomfield, N.J.
84923	Graybar Electric Co.	Oakland, Calif.	95354	Method Mfg. Co.	Chicago, Ill.
84965	United Transformer Co.	Chicago, Ill.	95566	Arnold Engineering Co.	Marengo, Ill.
85070	Bearing Eng'g. Inc.	Passaic, N.J.	95712	Dage Electric Co., Inc.	Franklin, Ind.
85146	ITT Cannon Elect. Inc., Salem Div.	Salem, Mass.	95984	Simon Mfg. Co.	Wayne, Ill.
85199	US Rubber Co., Consumer Ind. & Plastics Prod. Div.	Passaic, N.J.	95987	Huggins Laboratories	Sunnyvale, Calif.
85231	Graybar Electric Co.	Oakland, Calif.	95987	Whecker Co.	Chicago, Ill.
85236	General Mills, Inc.	Buffalo, N.Y.	96095	Hi-Q Div. of Aerovox Corp.	Clean, N.Y.
85264	Van Waters & Rogers Inc.	San Francisco, Calif.	96256	Thorndarson-Meissner Inc.	Los Angeles, Calif.
85265	National Coil Co.	Sheridan, Wyo.	96256	Solar Manufacturing Co.	Los Angeles, Calif.
85275	Vitamin, Inc.	Bridgport, Conn.	96330	Carlton Screw Co.	Chicago, Ill.
85348	Gordex Corp.	Bloomfield, N.J.			
85354	Method Mfg. Co.	Chicago, Ill.			
85566	Arnold Engineering Co.	Marengo, Ill.			
85712	Dage Electric Co., Inc.	Franklin, Ind.			
85984	Simon Mfg. Co.	Wayne, Ill.			
85987	Huggins Laboratories	Sunnyvale, Calif.			
86095	Hi-Q Div. of Aerovox Corp.	Clean, N.Y.			
86256	Thorndarson-Meissner Inc.	Los Angeles, Calif.			
86256	Solar Manufacturing Co.	Los Angeles, Calif.			
86330	Carlton Screw Co.	Chicago, Ill.			
86341	Microwave Associates, Inc.	Burlington, Mass.	96341	Microwave Associates, Inc.	Burlington, Mass.
96501	Excel Transformer Co.	Oakland, Calif.	96501	Excel Transformer Co.	Oakland, Calif.
97464	Industrial Retaining Ring Co.	Irvine, N.J.	97464	Industrial Retaining Ring Co.	Irvine, N.J.
97539	Automatic & Precision Mfg.	Englewood, N.J.	97539	Automatic & Precision Mfg.	Englewood, N.J.
97779	Reon Resistor Corp.	Yonkers, N.Y.	97779	Reon Resistor Corp.	Yonkers, N.Y.
97983	Lifton System Inc., Adler-Westrex	Yonkers, N.Y.	97983	Lifton System Inc., Adler-Westrex	Yonkers, N.Y.
98141	R-Tronics, Inc.	New Rochelle, N.Y.	98141	R-Tronics, Inc.	New Rochelle, N.Y.
98159	Rubber Teck, Inc.	Jamaica, N.Y.	98159	Rubber Teck, Inc.	Jamaica, N.Y.
98220	Hewlett-Packard Co., Moseley Div.	Pasadena, Calif.	98220	Hewlett-Packard Co., Moseley Div.	Pasadena, Calif.
98278	Microdot, Inc.	So. Pasadena, Calif.	98278	Microdot, Inc.	So. Pasadena, Calif.
98291	Sealco Corp.	Mamaroneck, N.Y.	98291	Sealco Corp.	Mamaroneck, N.Y.
98376	Zero Mfg. Co.	Burbank, Calif.	98376	Zero Mfg. Co.	Burbank, Calif.
98731	General Mills Inc., Electronics Div.	Burbank, Calif.	98731	General Mills Inc., Electronics Div.	Burbank, Calif.
98734	Paeco Div. of Hewlett-Packard Co.	Minneapolis, Minn.	98734	Paeco Div. of Hewlett-Packard Co.	Minneapolis, Minn.
98821	North Hills Electronics, Inc.	Palo Alto, Calif.	98821	North Hills Electronics, Inc.	Palo Alto, Calif.
98978	International Electronic Research Corp.	Palo Alto, Calif.	98978	International Electronic Research Corp.	Palo Alto, Calif.
99109	Columbia Technical Corp.	New York, N.Y.	99109	Columbia Technical Corp.	New York, N.Y.
99313	Varian Associates	Palo Alto, Calif.	99313	Varian Associates	Palo Alto, Calif.
99378	Altee Corp.	Winchester, Mass.	99378	Altee Corp.	Winchester, Mass.
99515	Marshall Ind. Elect. Products Div.	Winchester, Mass.	99515	Marshall Ind. Elect. Products Div.	Winchester, Mass.
99707	Control Switch Division, Controls Co.	San Marino, Calif.	99707	Control Switch Division, Controls Co.	San Marino, Calif.
99800	Devean Electronics Corp.	El Segundo, Calif.	99800	Devean Electronics Corp.	El Segundo, Calif.
99848	Wilco Corporation	Indianapolis, Ind.	99848	Wilco Corporation	Indianapolis, Ind.
99934	Renrandt, Inc.	Boston, Mass.	99934	Renrandt, Inc.	Boston, Mass.
99942	Hoffman Electronics Corp.	Boston, Mass.	99942	Hoffman Electronics Corp.	Boston, Mass.
99957	Technology Instrument Corp. of Calif.	Newbury Park, Calif.	99957	Technology Instrument Corp. of Calif.	Newbury Park, Calif.

THE FOLLOWING HP VENDORS HAVE NO NUMBER ASSIGNED IN THE LATEST SUPPLEMENT TO THE FEDERAL SUPPLY CODE FOR MANUFACTURERS HANDBOOK.

TABLE 6-3.

CODE LIST OF MANUFACTURERS (CONT'D)

## SECTION VII SCHEMATIC DIAGRAMS

### 7-1. INTRODUCTION.

7-2. This section contains schematic diagrams. Figure 7-1 lists notes and symbols which apply to all schematic diagrams. Each diagram follows the guide lines listed below.

a. Schematics in this manual are meant to show electrical circuit operation and not intended as wiring diagrams.

b. Assembly sections of schematics may or may not be shaded as in the example shown.

### 7-3. REPLACEMENT INFORMATION.

7-4. For repair and replacement information, refer to the MAINTENANCE section of this manual which is Section V. For specific component descriptions and/or ordering information refer to page 6-1.

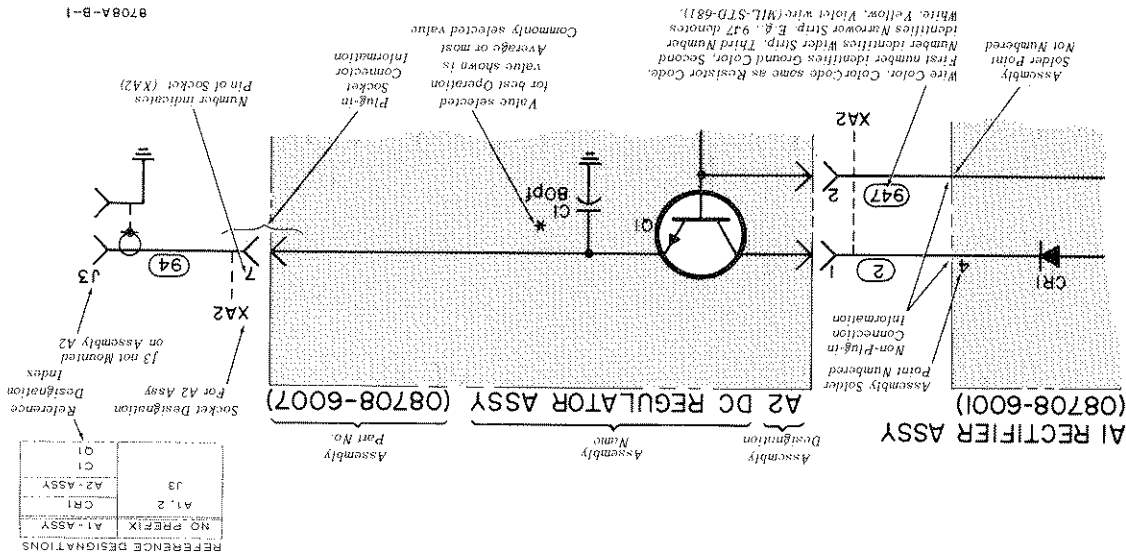
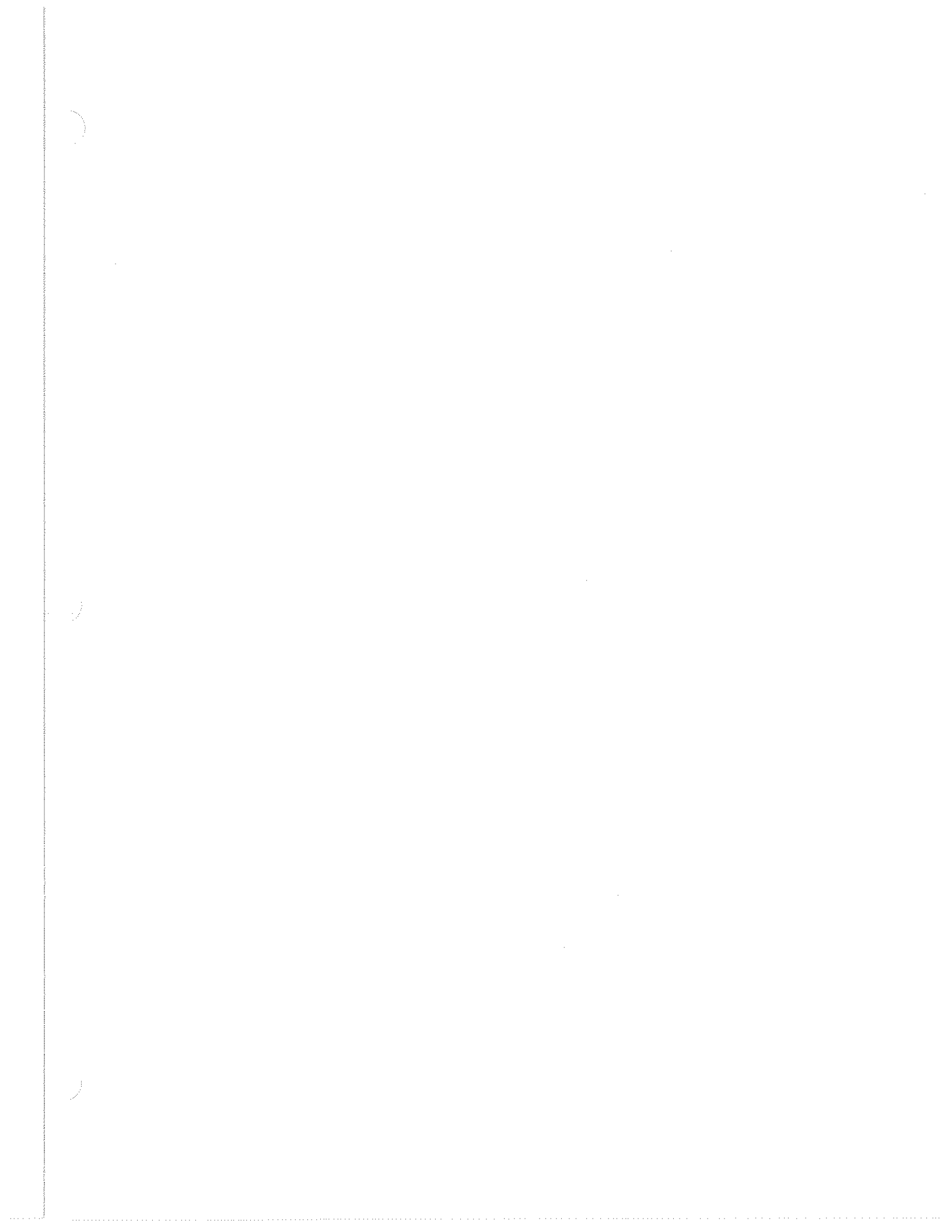


Figure 7-1. Schematic Information Illustration



# MANUAL CHANGES

MANUAL IDENTIFICATION  
 Model Number: 8406A  
 Date Printed: JUNE 1967  
 Part Number: 08406-90001

This supplement contains important information for correcting manual errors and for adapting the manual to instruments containing improvements made after the printing of the manual.

To use this supplement:

Make all ERRATA corrections

Make all appropriate serial number related changes indicated in the tables below.

Serial Prefix or Number	Make Manual Changes	Serial Prefix or Number	Make Manual Changes
737-00386 thru 737-00555	1, 2	1441A01266 thru 1441A01275	3, 4, 5, 6, 7
737-00556 thru 737-00585	1, 2, 3	1441A01276 thru 1441A Prefix	3, 4, 5, 6, 7, 8
737-00586 thru 737-00675	2, 3, 4	1628A, 1632A	3, 4, 5, 6, 7, 8, 9
961, 0961A	3, 4, 5	1711A	3, 4, 5, 6, 7, 8, 9, 10
1145A	3, 4, 5, 6	1915A	3 - 11

## NEW ITEM

## ERRATA

Inside front cover:

Insert new information regarding SAFETY, CERTIFICATION, and WARRANTY AND ASSISTANCE immediately inside front cover of manual (new information sheet supplied in this Manual Changes Supplement).

Page 1-1, General Information:

Add the following information preceding Paragraph 1-1:

## 1-A. SAFETY CONSIDERATIONS

### Operation

BEFORE APPLYING POWER, make sure the instrument's ac input is set for the available ac line voltage, that the correct fuse is installed, and that all normal safety precautions have been taken.

### Service

Although the instrument has been designed in

This instrument has been designed and tested according to IEC Publication 348, "Safety Requirements for Electronic Measuring Apparatus," and has been supplied in safe condition. This is a Safety Class I instrument.

## NOTE

Manual change supplements are revised as often as necessary to keep manuals as current and accurate as possible. Hewlett-Packard recommends that you periodically request the latest edition of this supplement. Free copies are available from all HP offices. When requesting copies quote the manual identification information from your supplement, or the model number and print date from the title page of the manual.

ERRATA (Cont'd)

accordance with international safety standards, the information, cautions, and warnings in this manual must be followed to ensure safe operation and to keep the instrument safe. Service and adjustments should be performed only by qualified service personnel.

Adjustment or repair of the opened instrument with the ac power connected should be avoided as much as possible and, when inevitable, should be performed only by a skilled person who knows the hazard involved.

Capacitors inside the instrument may still be charged even though the instrument has been disconnected from its source of supply.

Make sure only fuses of the required current rating and type (normal blow, time delay, etc.) are used for replacement. Do not use repaired fuses or short circuit the fuse holders.

Whenever it is likely that the protection has been impaired, make the instrument inoperative and secure it against any unintended operation.

**WARNING**

If this instrument is to be energized through an autotransformer (for voltage reduction), make sure the common terminal is connected to the earthed pole of the power source.

**BEFORE SWITCHING ON THE INSTRUMENT,** the protective earth terminals of the instrument must be connected to the protective conductor of the mains power cord. The mains plug shall only be inserted in a socket outlet provided with protective earth contact. The protection must not be

negated by using an extension cord (power cable) without a protective grounding conductor.

Any interruption of the protective (grounding) conductor, inside or outside the instrument, or disconnection of the protective earth terminal is likely to make this instrument dangerous. Intentional interruption of the earth ground is prohibited.

Servicing this instrument often requires that you work with the instrument's protective covers removed and with ac power connected. Be very careful; the energy at many points in the instrument may, if contacted, cause personal injury.

With the ac power cable connected, the ac line voltage is present at the terminals of the power line module and at the LINE power switch. Be very careful. Bodily contact with this voltage can be fatal.

**CAUTION**

**BEFORE SWITCHING ON THIS INSTRUMENT,** make sure instrument's ac input is set to the voltage of the ac power source.

**BEFORE SWITCHING ON THIS INSTRUMENT,** make sure that all devices connected to the instrument are connected to the protective earth ground.

make sure the line power (mains) plug is connected to a three-conductor line power outlet that has a protective (earth) ground. (Grounding one conductor of a two-conductor outlet is not sufficient.

**BEFORE SWITCHING ON THIS INSTRUMENT,** make sure the ac line fuse is of the required current rating and type (normal-blow, time-delay, etc.).



### **SAFETY**

This instrument has been designed and tested according to IEC Publication 348, "Safety Requirements for Electronic Measuring apparatus," and has been supplied in safe condition. This is a Safety Class I instrument. To ensure safe operation and to keep the instrument safe, the information, cautions, and warnings in this manual must be heeded. Refer to Section I for general safety considerations applicable to this instrument.

### **CERTIFICATION**

The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facilities, or to the calibration facilities of other International Standards Organization members.

### **WARRANTY AND ASSISTANCE**

This Hewlett-Packard product is warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery. Hewlett-Packard will repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard. No other warranty is expressed or implied. We are not liable for consequential damages.

Service contracts or customer assistance agreements are available for Hewlett-Packard products that require maintenance and repair on-site.

For any assistance, contact your nearest Hewlett-Packard Sales and Service Office.

ERRATA (Cont'd)

Page 5-3, Table 5-2, step e:  
Change 10-MC to read 1 MC.

Page 6-3, Table 6-1:  
Change to read:  
A1T1 08406-6013 Transformer: RF (Oscillator)

Page 6-4, Table 6-1:  
Change to read:

- ▲ A1T2 08406-6014 Transformer: RF (Amplifier)
- ▲ C2 Refer to Change 11 for PREFERRED REPLACEMENT
- ▲ C3 Refer to Change 11 for PREFERRED REPLACEMENT
- ▲ CRI 1901-0169 SEMICON DEVICE: DIODE
- ▲ CRIMP1 08406-6002 HOLDER ASSEMBLY, DIODE; INCLUDES:

08551-2041 POST, DIODE  
 1250-0014 CONTACT: OUTER N MALE CONNECTOR  
 1250-0016 RING: LOCKING FOR TYPE N CONNECTOR  
 5020-0306 NUT: CONNECTOR  
 08406-2002 BODY: DIODE HOLDER  
 08406-2003 CENTER CONDUCTOR  
 Add to Z1 Attenuator Pad Assy: Spacer 2 ea 08491-2102

Page 6-4, Table 6-1 and Page 6-7, Table 6-2:  
Change J1, J2 to read: 1250-0001 Connector: BNC

Page 6-4, Table 6-1; Page 6-7, Table 6-2; Page 7-3/7-4, Figure 7-2:  
Change R1 to read: 2100-0350 R: VAR COMP 1.5K OHM 20% L1N 1/2W

Page 6-9, Table 6-2:

Add: 08406-6013 Transformer: RF (Oscillator)  
 08406-6014 Transformer: RF (Amplifier)  
 08491-2102 Spacer: Attenuator Pad Assy

Page 7-3, Figure 7-2:  
Change (906) at wiper of R3 (top part of schematic) to (904)

Page 7-5, Figure 7-3:  
 Change (908) to (918) at line input.  
 Change (908) to (918) at line input.

CHANGE 1

Page 6-2, Table 6-1; Page 6-7, Table 6-2; Page 7-3/7-4, Figure 7-2:  
Change A1C17 to C: FXD MICA 33 pF 300 V 5% 0160-0179

CHANGE 2

Page 6-4, Table 6-1; Page 6-8, Table 6-2; Page 7-3/7-4, Figure 7-2:  
Change R1 to R: VAR COMP 1500 OHM 20% L1N 1/2W 2100-0350

CHANGE 3

Page 6-1, Table 6-1; Page 7-5/7-6, Figure 7-3:  
 Change to read: A1Q8 1850-0040 Transistor: Germanium PNP  
 A1Q9 1853-4051 Transistor: Silicon 2N4037  
 A1R30 0683-0395 R: FXD COMP 3.9 OHM 5% 1/4W

Page 6-4, Table 6-1:

Change to read:  
 A1VR1 1902-3203 DIODE BREAKDOWN: SILICON 14.7V 5% 400 mW  
 Add:  
 A1MP1 1205-0011 HEAT DISSIPATOR: TO-5/9 CASE USED ON A1Q9



**CHANGE 6**

Page 6-2, Table 6-1 and Page 7-3/7-4, Figure 7-2:  
Change A1C17 to C:FXD MICA 60 pF 300 V 5% 0140-0214 (\*) Factory Selected Component.

Page 6-5, Table 6-1:  
Add: 0370-1400 KNOB, MINT GRAY PUSHBUTTON 11/16 IN DIA 1MC, 10MC, 100MC EXT TRIG.

Page 6-6, Table 6-1 Cabinet Parts:  
Change items 6 through 10 to read:

6	5000-8565	COVER:SIDE (OLIVE GRAY)
7	5060-8555	COVER ASSEMBLY:TOP (OLIVE GRAY)
8	5000-8571	COVER ASSEMBLY:BOTTOM (OLIVE GRAY)
9	08406-00015	PANEL:REAR
10	08406-00017	PANEL:FRONT (MINT GRAY)

**CHANGE 7**

Page 6-4, Table 6-1:

Change R1 to 2100-2769, R:VAR 2.5K OHM 20% 2W.

**CHANGE 8**

Page 6-2, Table 6-1:

Change A1C6 to 0160-2306, C:FXD CER 27 pF 5% 300 V, Factory Selected Part.  
Change A1C17 to 0140-0145, C:FXD MICA 22 pF 5% 500 VDCW, Factory Selected Part.

Page 7-3, Figure 7-2:

Change the value of A1C6 to A1C6 \* 27 pF.  
Change the value of A1C17\* to 22 pF.

**CHANGE 9**

Page 1-1, Table 1-1:

Change "Peak amplitude\*" to "Typical amplitude\*";





**APPENDIX I**

## BACKDATING INFORMATION

This manual applies to instruments with Serial Prefixes 649-, and 737-. Listed below are changes to be made to the manual so that it will apply directly to Prefixes 532-, and 541-.

Instrument Serial No. Prefix		Change Number
541-		1
532-		1 and 2

## CHANGE 1:

Table 6-1 Page	Table 6-2 Page	Schematic Page	Delete, Change, or add	Circuit Ref.	Stk No.	Item Description
6-2	6-7	7-3/7-4	Change	A1C7	0121-0031	C: Var 1.85-10.38 pF
"	"	"	"	A1C18	"	"
"	"	"	"	A1C39	"	"

## CHANGE 2:

6-7	6-7	7-3/7-4	Change	A1C29	0160-0370	20 pF 5%
6-3		"	"	A1L11	9100-1612	0.33 $\mu$ H
"		"	"	A1Q5	1854-0031	2N2865
"		"	"	A1Q7	1854-0031	2N2865
"		"	"	A1R20	0698-3156	14.7 K $\Omega$
"		"	"	A1R21	0698-3155	4640 $\Omega$
"		"	"	A1R22	0698-0084	2150 $\Omega$
6-2		"	Delete	A1C41	-	-
6-3		"	"	A1R31	-	-
"		"	"	A1R32	-	-

- ANGOLA**  
Electra  
Empresa Técnica de Equipamentos Eléctricos, S.A.R.L.  
R. Barbosa Rodrigues, 41-1\*DT,\*  
Caixa Postal. 6487  
Tel: 35515/6
- ARGENTINA**  
Hewlett-Packard Argentina S.A.  
Santa Fe 2035, Marfinez  
6140 Buenos Aires  
Tel: 792-1239, 798-6086  
Telex: 122443 AR OGY
- Biotron S.A.C.I.y.M.  
Avda. Paseo Colon 221  
9 piso  
1399 Buenos Aires  
Tel: 30-4846/185/18384  
34-9356/0460/4551  
Telex: (33) 17595 BID AR
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**AUSTRALIA CAPITAL TERR.**  
Hewlett-Packard Australia Pty. Ltd.  
121 Wollongong Street  
Fyshwick, 2609  
Tel: 804244  
Telex: 62650
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Hewlett-Packard Australia Pty. Ltd.  
31 Bridge Street  
Pymble, 2073  
Tel: 4496566  
Telex: 21561
- QUEENSLAND**  
Hewlett-Packard Australia Pty. Ltd.  
5th Floor  
Teachers Union Building  
495-499 Boundary Street  
Spring Hill, 4090  
Tel: 2291544
- SOUTH AUSTRALIA**  
Hewlett-Packard Australia Pty. Ltd.  
153 Greenhill Road  
Parkside, 5063  
Tel: 2725911  
Telex: 82536
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Hewlett-Packard Australia Pty. Ltd.  
31-41 Joseph Street  
Blackburn, 3130  
Tel: 89-6351  
Telex: 31024 MELB
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Hewlett-Packard Australia Pty. Ltd.  
141 Stirling Highway  
Nedlands, 6009  
Tel: 3865455  
Telex: 93859
- AUSTRIA**  
Hewlett-Packard Ges.m.b.H.  
Wehlstrasse 29  
P.O. Box 7  
A-1205 Vienna  
Tel: 35-16-21-0  
Telex: 13582/135066
- Hewlett-Packard Ges.m.b.H.  
Wehlstrasse, 29  
A-1205 Wien  
Tel: 35-16-21-0  
Telex: 135066
- BAHRAIN**  
Medical Only  
Wael Pharmacy  
P.O. Box 648  
Bahrain  
Tel: 54886, 56123  
Telex: 8550 WAEI GJ
- Al Hamdiya Trading and Contracting  
P.O. Box 20074  
Manama  
Tel: 259978, 259958  
Telex: 8895 KALDIA GJ
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The General Electric Co. of Bangladesh Ltd.  
Magnet House 72  
Dikusha Commercial Area  
Motijheel, Dacca 2  
Tel: 252415, 252419  
Telex: 734
- BELGIUM**  
Hewlett-Packard Benelux S.A./N.V.  
Avenue du Col-Vert, 1,  
(Grootkraaglaan)  
B-1170 Brussels  
Tel: (02) 660 50 50  
Telex: 23-494 patoben br
- BRAZIL**  
Hewlett-Packard do Brasil I.e.C. Ltda.  
Alameda Rio Negro, 750  
Alphaville  
06400 Barueri SP  
Tel: 429-3222
- Hewlett-Packard do Brasil I.e.C. Ltda.  
Rua Padre Chagas, 32  
90000-Pôrto Alegre-RS  
Tel: 22-2968, 22-5621
- Hewlett-Packard do Brasil I.e.C. Ltda.  
Av. Epitacio Pessoa, 4664  
22471-Rio de Janeiro-RJ  
Tel: 286-0237  
Telex 021-21905 HPBR-BR
- CANADA**  
**ALBERTA**  
Hewlett-Packard (Canada) Ltd.  
11620A - 168th Street  
Edmonton T5M 3T9  
Tel: (403) 452-3670  
TWX: 610-831-2431
- Hewlett-Packard (Canada) Ltd.  
210, 7220 Fisher St. S.E.  
Calgary T2H 2H6  
Tel: (403) 253-2713  
TWX: 610-821-6141
- BRITISH COLUMBIA**  
Hewlett-Packard (Canada) Ltd.  
10691 Sheilbridge Way  
Richmond V6X 2W7  
Tel: (604) 270-2277  
TWX: 610-925-5059
- MANITOBA**  
Hewlett-Packard (Canada) Ltd.  
380-550 Century St.  
St. James,  
Winnipeg R3H 0Y1  
Tel: (204) 786-6701  
TWX: 610-671-3531
- NOVA SCOTIA**  
Hewlett-Packard (Canada) Ltd.  
P.O. Box 931  
800 Windmill Road  
Dartmouth B3B 1L1  
Tel: (902) 469-7820  
TWX: 610-271-4482
- ONTARIO**  
Hewlett-Packard (Canada) Ltd.  
3020 Morrison Dr.  
Ottawa K2H 8K7  
Tel: (613) 820-6483  
TWX: 610-563-1636
- Hewlett-Packard (Canada) Ltd.  
6877 Goreway Drive  
Mississauga L4V 1M8  
Tel: (416) 678-9430  
TWX: 610-492-4246
- Hewlett-Packard (Canada) Ltd.  
552 Newbold Street  
London N6E 2S5  
Tel: (519) 686-9181  
TWX: 610-352-1201
- QUEBEC**  
Hewlett-Packard (Canada) Ltd.  
275 Hymus Blvd.  
Pointe Claire H9R 1G7  
Tel: (514) 697-4232  
TWX: 610-422-3022
- FOR CANADIAN AREAS NOT LISTED:**  
Contact Hewlett-Packard (Canada) Ltd. in Mississauga.
- CHILE**  
Hewlett-Packard (Canada) Ltd.  
Jorge Calcagni y Cia. Ltda.  
Arturo Burtie 065  
Casilla 15475  
Correo 9, Santiago  
Tel: 220222  
Telex: JCALCAGNI
- COLOMBIA**  
Instrumentación  
Henrik A. Langebaek & Kier S.A.  
Carrera 7 No. 48-75  
Apartado Aéreo 6287  
Bogotá, 1 D.E.  
Tel: 269-8877  
Telex: 44400
- Instrumentación  
H.A. Langebaek & Kier S.A.  
Carrera 63 No. 49-A-31  
Apartado 54098  
Medellin  
Tel: 304475
- COSTA RICA**  
Científica Costarricense S.A.  
Avenida 2, Calle 5  
San Pedro de Montes de Oca  
Apartado 10159  
San José  
Tel: 24-38-20, 24-08-19  
Telex: 2367 GALGUR CR
- CYPRUS**  
Kytronics  
19 Gregorios Xenopoulos  
Street  
P.O. Box 1152  
Nicosia  
Tel: 45628/29  
Telex: 3018
- CZECHOSLOVAKIA**  
Hewlett-Packard  
Obchodni zastupitelství v CSSR  
Psemny styk  
Post. schranka 27  
CS 118 01 Praha 011  
CSSR  
Vývojoiva a Provozní Zakladna  
Vyzkumných Ustavu v  
Bechovicích  
CSSR-25097 Bechovice u  
Prahy  
Tel: 89 93 41  
Telex: 12133  
institute of Medical Bionics  
Vyskumny Ustav Lekarskej  
Bioniky  
Jedlova 6  
CS-88346 Bratislava-  
Kramare  
Tel: 44-551  
Telex: 93229
- DENMARK**  
Hewlett-Packard A/S  
Datavej 52  
DK-3460 Birkerød  
Tel: (02) 81 66 40  
Telex: 37409 hpas dk
- Hewlett-Packard A/S  
Navervej 1  
DK-8600 Silkeborg  
Tel: (06) 82 71 66  
Telex: 37409 hpas dk
- ECUADOR**  
CYEDE Cia. Ltda.  
P.O. Box 6423 CCI  
Av. Eloy Alfaro 1749  
Quito  
Tel: 450-975, 243-052  
Telex: 2548 CYEDE ED
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Hospitalar S.A.  
Casilla 3590  
Robles 625  
Quito  
Tel: 545-250
- EGYPT**  
I.E.A.  
International Engineering  
Associates  
24 Hussein Hegazi Street  
Kasr-el-Aim  
Cairo  
Tel: (416) 678-9430  
TWX: 610-492-4246  
Telex: 93830
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Sami Amin Trading Office  
18 Abdel Aziz Gawish  
Abdine-Cairo  
Tel: 24932
- EL SALVADOR**  
IPESA  
Bulevar de los Heroes 11-48  
Edificio Sarah 1148  
San Salvador  
Tel: 252787
- ETHIOPIA**  
Abdella Abdulmalik  
P.O. Box 2635  
Addis Ababa  
Tel: 11 93 46
- FINLAND**  
Hewlett-Packard Oy  
Revontulente, 7  
SF-02100 Espoo 10  
Tel: (09) 453 0211  
Telex: 121563 hewpa sf
- FRANCE**  
Hewlett-Packard France  
Zone d'activités de  
Courtatouef  
Avenue des Tropiques  
Boite Postale 6  
91401 Orsay-Cédex  
Tel: (1) 907 78 25  
TWX: 600048F
- Hewlett-Packard France  
Chemin des Mouilles  
B.P. 162  
69130 Ecully  
Tel: (78) 33 81 25  
TWX: 310617F
- Hewlett-Packard France  
20, Chemin de La Cèprière  
31081 Toulouse  
Le Mirail-Cédex  
Tel: (61) 40 11 12
- Hewlett-Packard France  
Le Ligoures  
Place Romée de Vileneuve  
13100 Aix-en-Provence  
Tel: (42) 59 41 02  
TWX: 410770F
- Hewlett-Packard France  
2, Allée de la Bourgonette  
35100 Rennes  
Tel: (99) 51 42 44  
TWX: 740912F
- Hewlett-Packard France  
18, rue du Canal de la Maine  
67300 Schiltigheim  
Tel: (88) 83 08 10  
TWX: 890141F
- Hewlett-Packard France  
Immeuble péronière  
rue van Gogh  
59650 Villeneuve D'Ascq  
Tel: (20) 91 41 25  
TWX: 36678 HX
- Hewlett-Packard France  
Bâtiment Ampère  
Rue de la Commune de Paris  
B.P. 300  
93153 Le Blanc Mesnil-  
Cédex  
Tel: (01) 931 88 50  
Telex: 211032F
- Hewlett-Packard France  
Av. du Pdt. Kennedy  
33700 Mérignac  
Tel: (56) 97 01 81
- Hewlett-Packard France  
Immeuble Lorraine  
Boulevard de France  
91035 Evry-Cédex  
Tel: 077 96 60  
Telex: 692315F
- Hewlett-Packard France  
23 Rue Lothaire  
57000 Metz  
Tel: (87) 65 53 50
- GERMAN FEDERAL REPUBLIC**  
Hewlett-Packard GmbH  
Vertriebszentrale Frankfurt  
Berner Strasse 117  
Postfach 560 140  
D-6000 Frankfurt 56  
Tel: (06011) 50041  
Telex: 04 13249 hpffm d
- Hewlett-Packard GmbH  
Technisches Büro Böblingen  
Herrenberger Strasse 110  
D-7030 Böblingen,  
Württemberg  
Tel: (07031) 667-1  
Telex: 07265739 bbn
- Hewlett-Packard GmbH  
Technisches Büro Düsseldorf  
Emanuel-Leutze-Str. 1  
(Seestern)  
D-4000 Düsseldorf  
Tel: (0211) 5971-1  
Telex: 085786 533 hpdd d
- Hewlett-Packard GmbH  
Technisches Büro Hamburg  
Kapsladring 5  
D-2000 Hamburg 80  
Tel: (040) 63804-1  
Telex: 21 63 032 hpnh d
- Hewlett-Packard GmbH  
Technisches Büro Hannover  
Am Grossmarkt 6  
D-3000 Hannover 91  
Tel: (0511) 46 60 01  
Telex: 092 3259
- Hewlett-Packard GmbH  
Technisches Büro Nürnberg  
Neumeyersstrasse 90  
D-8500 Nürnberg  
Tel: (0911) 52 20 83  
Telex: 0623 860
- Hewlett-Packard GmbH  
Technisches Büro München  
Eschenstrasse 5  
D-8021 Taufkirchen  
Tel: 0524985
- Hewlett-Packard GmbH  
Technisches Büro Berlin  
Kathstrasse 2-4  
D-1000 Berlin 30  
Tel: (030) 24 90 86  
Telex: 018 3405 hpbn d
- Hewlett-Packard GmbH  
Kostas Karayannis  
8 Omarou Street  
Athens 133  
Tel: 32 30 303/32 37 731  
Telex: 21 59 82 RKAR GR
- Hewlett-Packard France  
Guam Medical Supply, Inc.  
Sute C, Airport Plaza  
P.O. Box 8947  
Tamuning 96911  
Tel: 646-4513
- GUATEMALA**  
IPESA  
Avenida Reforma 3-48  
Zona 9  
Guatemala City  
Tel: 316627, 314786,  
664715, ext. 9  
Telex: 4192 Teletro Gu
- HONG KONG**  
Hewlett-Packard Hong Kong Ltd.  
11th Floor, Four Seas Bldg.  
212 Nathan Rd.  
Kowloon  
Tel: 3-697446 (5 lines)  
Telex: 36678 HX
- Medical/Analytical Only  
Schmidt & Co. (Hong Kong)  
Wing On Centre, 28th Floor  
Connaught Road, C.  
Hong Kong  
Tel: 5-455644  
Telex: 74766 SCHMX HX
- INDIA**  
Blue Star Ltd.  
Sahas  
41/42 Vir Savarkar Marg  
Prabhadevi  
Bombay 400 025  
Tel: 45 78 87  
Telex: 011-4093
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Band Box House  
Prabhadevi  
Bombay 400 025  
Tel: 45 73 01  
Telex: 011-3751
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Bhandari House  
91 Nehru Place  
New Delhi 110 024  
Tel: 682547  
Telex: 031-2463
- Blue Star Ltd.  
T.C. 7/603 'Poomina'  
Masulipakuzhi  
Trivandrum 695 013  
Tel: 65799  
Telex: 0884-259
- Blue Star Ltd.  
11 Magarath Road  
Bangalore 560 025  
Tel: 55668  
Telex: 0845-430
- Blue Star Ltd.  
Meeakshi Mandram  
XXXV/1379-2 Mahatma  
Gandhi Rd.  
Cochin 682 016  
Tel: 32069  
Telex: 085-514
- Blue Star Ltd.  
1-117/1 Sarojini Devi Road  
Secunderabad 500 039  
Tel: 70126  
Telex: 0155-459
- Blue Star Ltd.  
133 Kodambakkam High Road  
Madras 600 034  
Tel: 82057  
Telex: 041-379
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P.O. Box 895  
IS-Reykjavik  
Tel: 1 58 201 63 03
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Jln. Abdul Muis 62  
Jakarta  
Tel: 349255, 349886  
Telex: 46748 BERSIL IA
- BERCA Indonesia P.T.  
P.O. Box 174/Sb7.  
23 Jln. Jemerlo  
Surabaya  
Tel: 42027  
Telex: 42027
- IRELAND**  
Hewlett-Packard Ltd.  
Kestrel House  
Clanwilliam Place  
Lower Mount Street  
Dublin 2, Eire  
Hewlett-Packard Ltd.  
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Long Mile Road  
Dublin 12  
Tel: 514322/514224  
Telex: 30439
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Kilmore Road  
Artane  
Dublin 5, Eire  
Tel: (01) 315820
- Medical Only  
Cardiac Services Co.  
95A Finaghy Rd. South  
Belfast BT10 0BY  
GB-Northern Ireland  
Tel: (0232) 625566  
Telex: 747626
- ISRAEL**  
Electronics Engineering Div.  
of Motorola Israel Ltd.  
16, Kremenetski Street  
P.O. Box 25016  
Tel-Aviv  
Tel: 38973  
Telex: 33569, 34164
- ITALY**  
Hewlett-Packard Italiana S.p.A.  
Via G. Di Vittorio, 9  
20063 Cornusco Sul  
Naviglio (MI)  
Tel: (2) 903691  
Telex: 334632 HEWPACKIT
- Hewlett-Packard Italiana S.p.A.  
Corso Giovanni Lanza 94  
I-10133 Torino  
Tel: (011) 659308  
Telex: 221079
- Hewlett-Packard Italiana S.p.A.  
Via Principe Nicola 43 G/C  
I-95126 Catania  
Tel: (095) 37 05 04  
Telex: 979291
- Hewlett-Packard Italiana S.p.A.  
Via Nuova San Rocco A  
Capadimonte, 62A  
80131 Napoli  
Tel: (081) 710698
- Hewlett-Packard Italiana S.p.A.  
Via Martin Luther King, 38/111  
I-40132 Bologna  
Tel: (051) 402394  
Telex: 511830
- JAPAN**  
Yokogawa-Hewlett-Packard Ltd.  
29-21, Takaido-Higashi  
3-chome  
Suginami-ku, Tokyo 168  
Tel: 03-331-6111  
Telex: 232-2024 YHP-Tokyo
- Yokogawa-Hewlett-Packard Ltd.  
Chuo Bldg., 4th Floor  
4-20, Nishinakajima 5-chome  
Yodogawa-ku, Osaka-shi  
Osaka, 532  
Tel: 06-304-6021  
Telex: 523-3624
- Yokogawa-Hewlett-Packard Ltd.  
Sunitomo Semei Nagaya Bldg.  
11-2 Shimosasajima-cho,  
Nakamura-ku, Nagoya, 450  
Tel: 052 571-5171
- Yokogawa-Hewlett-Packard Ltd.  
Tangawa Building  
2-24-1 Tsuruya-cho  
Kanagawa-ku  
Yokohama, 221  
Tel: 045-312-1252  
Telex: 382-3204 YHP YOK
- Yokogawa-Hewlett-Packard Ltd.  
Mitsui Building  
105, 1-chome, San-no-maru  
Mito, Ibaragi 310  
Tel: 0292-25-7470
- Yokogawa-Hewlett-Packard Ltd.  
Inoue Building  
1348-3, Asahi-cho, 1-chome  
Atsugi, Kanagawa 243  
Tel: 0462-24-0452
- Yokogawa-Hewlett-Packard Ltd.  
Kumagaya Asahi  
Hachijuri Building  
4-4, Tsukuba  
Kumagaya, Saitama 360  
Tel: 0485-24-6563
- JORDAN**  
Mousher Cousins Co  
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Amman  
Tel: 24907/39607  
Telex: SABCO JO 1456
- KENYA**  
ADCOM Ltd., Inc.  
P.O. Box 30070  
Nairobi  
Tel: 331955  
Telex: 22639
- Medical Only  
International Aeradio (E.A.) Ltd  
P.O. Box 19012  
Nairobi Airport  
Nairobi  
Tel: 336055/56  
Telex: 22201/22301
- Medical Only  
International Aeradio (E.A.) Ltd  
P.O. Box 95221  
Mombasa  
Tel: (2) 903691  
Telex: 334632 HEWPACKIT
- Hewlett-Packard Italiana S.p.A.  
Via Turazza, 14  
35100 Padova  
Tel: (49) 664888  
Telex: 430315 HEWPACKIT
- Hewlett-Packard Italiana S.p.A.  
Via G. Arminio 10  
I-00143 Roma  
Tel: (06) 54 69 61  
Telex: 610514
- Hewlett-Packard Italiana S.p.A.  
Corso Giovanni Lanza 94  
I-10133 Torino  
Tel: (011) 659308  
Telex: 221079
- Hewlett-Packard Italiana S.p.A.  
Via Principe Nicola 43 G/C  
I-95126 Catania  
Tel: (095) 37 05 04  
Telex: 979291
- Hewlett-Packard Italiana S.p.A.  
Via Nuova San Rocco A  
Capadimonte, 62A  
80131 Napoli  
Tel: (081) 710698
- Hewlett-Packard Italiana S.p.A.  
Via Martin Luther King, 38/111  
I-40132 Bologna  
Tel: (051) 402394  
Telex: 511830
- JAPAN**  
Yokogawa-Hewlett-Packard Ltd.  
29-21, Takaido-Higashi  
3-chome  
Suginami-ku, Tokyo 168  
Tel: 03-331-6111  
Telex: 232-2024 YHP-Tokyo
- Yokogawa-Hewlett-Packard Ltd.  
Chuo Bldg., 4th Floor  
4-20, Nishinakajima 5-chome  
Yodogawa-ku, Osaka-shi  
Osaka, 532  
Tel: 06-304-6021  
Telex: 523-3624
- Yokogawa-Hewlett-Packard Ltd.  
Sunitomo Semei Nagaya Bldg.  
11-2 Shimosasajima-cho,  
Nakamura-ku, Nagoya, 450  
Tel: 052 571-5171
- Yokogawa-Hewlett-Packard Ltd.  
Tangawa Building  
2-24-1 Tsuruya-cho  
Kanagawa-ku  
Yokohama, 221  
Tel: 045-312-1252  
Telex: 382-3204 YHP YOK
- MOZAMBIQUE**  
A.N. Goncalves, Ltd.  
162, 1<sup>st</sup> Apt. 14 Av. D. Luis  
Caixa Postal 107  
Maputo  
Tel: 27091, 27114  
Telex: 6-203 NEGON MO
- NETHERLANDS**  
Hewlett-Packard Benelux N.V.  
Van Heuven Goedhartlaan 121  
P.O. Box 667  
1181KK Amstelveen  
Tel: (20) 47 20 21  
Telex: 13 216
- NEW ZEALAND**  
Hewlett-Packard (N.Z.) Ltd.  
4-12 Cruickshank Street  
Kilbirnie, Wellington 3  
P.O. Box 9443  
Courtenay Place  
Wellington  
Tel: 877-199
- Hewlett-Packard (N.Z.) Ltd.  
169 Manukau Road  
Epsom, Auckland  
Tel: 687-159
- Analytical/Medical Only  
Northrop Instruments &  
Systems Ltd.,  
Sturdee House  
85-87 Ghuznee Street  
P.O. Box 2406  
Wellington  
Tel: 850-091  
Telex: NZ 31291
- Northrop Instruments &  
Systems Ltd.  
Eden House, 44 Khyber Pass  
Rd.  
P.O. Box 9682, Newmarket  
Auckland 1  
Tel: 794-091
- Northrop Instruments &  
Systems Ltd.  
Terrace House, 4 Oxford  
Terrace  
P.O. Box 8388  
Christchurch  
Tel: 64-165
- NIGERIA**  
The Electronics  
Instrumentations Ltd.  
NS8/770oyo Road  
Clusean House  
P.M.B. 5402  
Ibadan  
Tel: 461577
- The Electronics  
Instrumentations Ltd.  
144 Agege Motor Road, Mushin  
P.O. Box 481  
Mushin, Lagos  
Tel: 461577
- NORWAY**  
Hewlett-Packard Norge A/S  
Ostendalen 18  
P.O. Box 34  
1345 Osteraaes  
Tel: (02) 1711 80
- Hewlett-Packard Norge A/S  
Nygaardsgaten 114  
P.O. Box 4210  
5013 Nygaardsgaten,  
Bergen  
Tel: (05) 21 97 33
- PANAMA**  
Electrónico Balboa, S.A.  
Aparatado 4929  
Panama 5  
Calle Samuel Lewis  
Edificio "Alfa," No. 2  
Ciudad de Panama  
Tel: 64-2700  
Telex: 3483103 Curundu,  
Canai Zone
- PERU**  
Compañía Electro Médica S.A.  
Los Flamencos 145  
San Isidro Casilla 1030  
Lima 1  
Tel: 41-4325  
Telex: Pub. Booth 25424  
SISBRO
- PAKISTAN**  
Mushko & Company Ltd.  
Osman Chambers  
Abdullah Haroon Road  
Karachi-3  
Tel: 511027, 512927  
Telex: 2894